VOL. 23, No. 10 OCTOBER, 1946

THE LIBRARY OF CONGRESS SERIAL RECORD
OCT 21 1946
Copy

AMERICAN JOURNAL OF OPTOMETRY *and* ARCHIVES *of* AMERICAN ACADEMY OF OPTOMETRY

EDITORIAL COUNCIL

R. E. BANNON, *Hanover, N. H.*
I. M. BORISH, *Kokomo, Ind.*
H. M. FISHER, *New York, N. Y.*
GLENN A. FRY, *Columbus, Ohio*
R. M. HALL, *Cleveland, Ohio*
E. E. HOTALING, *New York, N. Y.*
D. G. HUMMEL, *Cleveland, Ohio*
C. W. MORRIS, *Fort Wayne, Ind.*
J. F. NEUMUELLER, *Philadelphia, Pa.*
D. R. PAINE, *Topeka, Kan.*
E. PETRY, *Rochester, N. Y.*
E. LEROY RYER, *New York, N. Y.*

EDITORS

CAREL C. KOCH, *Minneapolis, Minn.*

J. FRED ANDREAE, *Baltimore, Md.*
ARTHUR P. WHEELOCK, *Des Moines, Iowa*

COLLABORATORS

A. N. ABBOTT, *Shawano, Wis.*
E. ALLGAIER, *Washington, D. C.*
M. ALPERN, *Lorain, Ohio*
N. M. BAXTER, *New Bern, N. C.*
R. C. BAXTER, *Warren, Ohio*
T. R. BELL, *Alpena, Mich.*
E. A. BETTS, *State College, Pa.*
A. G. BILLMEIER, *Denton, Md.*
S. M. BRAFF, *Los Angeles, Calif.*
E. E. BRANN, *Independence, Kan.*
H. F. BRANT, *Des Moines, Iowa*
C. S. BRIDGMAN, *Columbus, Ohio*
F. W. BROCK, *Staten Island, N. Y.*
G. L. BROWN, *Paulsboro, N. J.*
J. J. BROWN, *Perth Amboy, N. J.*
M. N. CHODROFF, *Brooklyn, N. Y.*
R. F. COOPS, *Los Angeles, Calif.*
J. C. COPELAND, *Chicago, Ill.*
J. R. DEAN, *Los Angeles, Calif.*
W. E. DEWEY, *Battle Creek, Mich.*
I. DVORINE, *Baltimore, Md.*
M. T. EBERL, *Milwaukee, Wis.*
V. J. ELLERBROCK, *Hanover, N. H.*
T. A. W. ELMGREN, *Columbia, S. C.*
A. B. EMMES, *Richmond, Calif.*
H. W. EWALT, JR., *Pittsburgh, Pa.*
W. S. FARMER, *Oklahoma City, Okla.*
R. FEINBERG, *Layfette, Ind.*
W. FEINBLOOM, *New York, N. Y.*
L. P. FOLSOM, *South Royalton, Vt.*
H. L. FOUG, *Los Angeles, Calif.*
E. FREEMAN, *Chicago, Ill.*
W. H. GLAZER, *Philadelphia, Pa.*
E. I. GOODLAW, *Los Angeles, Calif.*
J. G. GOODSELL, *Los Angeles, Calif.*
R. C. GRAHAM, *Dayton, Ohio*
W. GREENSPON, *Bluefield, W. Va.*
R. GREENSPOON, *Beverly Hills, Calif.*
D. E. GRIM, *Des Moines, Iowa*
H. F. HAINES, *Columbus, Ohio*
W. J. HEATHER, *Southbridge, Mass.*
A. E. HOARE, *Los Angeles, Calif.*
H. W. HOFSTETTER, *Columbus, Ohio*
E. A. HUTCHINSON, *Los Angeles, Calif.*
O. H. JOHNSON, *Jonesboro, Ark.*
R. S. JORDAN, *Cleveland, Ohio*
J. C. KEHOE, *Flint, Mich.*
W. M. KETCHUM, *Los Angeles, Calif.*
G. F. KINTNER, *Wabash, Ind.*
L. H. KRASKIN, *Washington, D. C.*
M. LUCKIESH, *Cleveland, Ohio*
G. A. MACELREE, *Philadelphia, Pa.*
O. L. MCCULLOCH, *Holyoke, Mass.*
E. J. MARGARETTEN, *New York, N. Y.*
H. B. MARTON, *Manchester, Eng.*
J. W. MOGEY, *Flushing, N. Y.*
M. W. MORGAN, *Berkeley, Calif.*
J. C. NEIL, *Philadelphia, Pa.*
J. S. NUPUF, *Canton, Ohio*
G. A. PARKINS, *Ord, Nebr.*
H. E. PINE, *Chicago, Ill.*
C. A. RADDE, *Cleveland, Ohio*
E. E. REESE, *Westerville, Ohio*
R. J. ROTH, *Southbridge, Mass.*
C. I. SAKS, *Syracuse, N. Y.*
A. A. SCHMIDT, *Cleveland, Ohio*
C. SHEARD, *Rochester, Minn.*
J. ROBERT SHREVE, *Indianapolis, Ind.*
S. H. SHURIN, *Kansas City, Mo.*
R. E. SIMPSON, *Pasadena, Calif.*
W. SMITH, *Boston, Mass.*
E. J. SOLAND, *Indianapolis, Ind.*
P. L. SPENCER, *Claremont, Calif.*
K. B. STODDARD, *Berkeley, Calif.*
M. A. TINKER, *Minneapolis, Minn.*
A. H. TWEEDLE, *Kenora, Ont.*
R. N. WALKER, *Winston-Salem, N. C.*
R. WALSH, *Bloomington, Ill.*
G. H. WARKENTINE, *Cedar Rapids, Iowa*
E. G. WISEMAN, *Buffalo, N. Y.*
A. T. WRAY, *Los Angeles, Calif.*

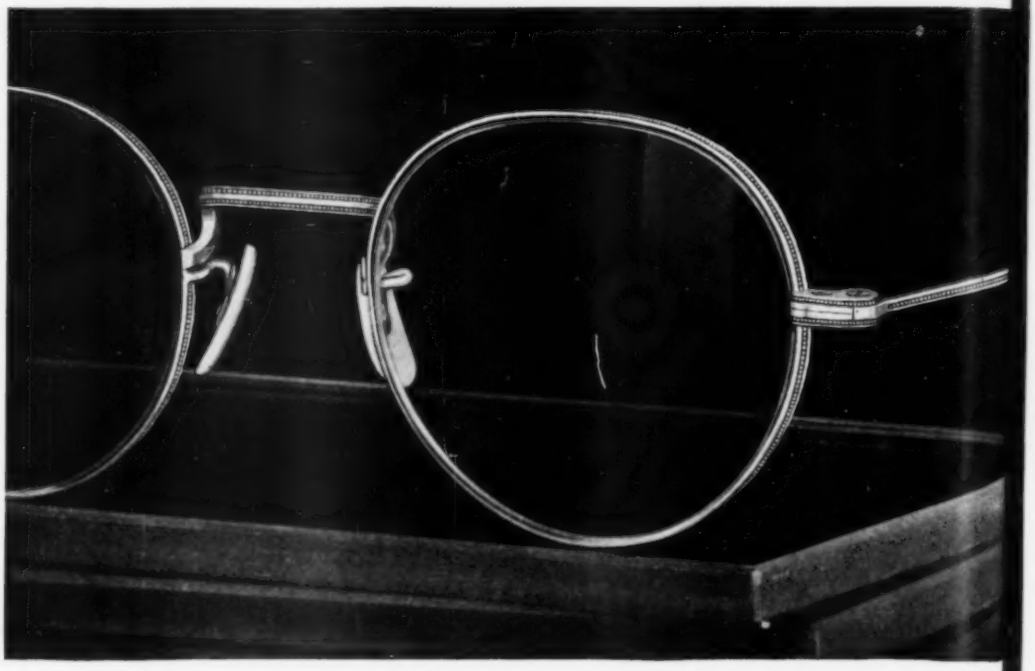
Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION,
1502 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

ANNUAL SUBSCRIPTION $5.00 CANADA $5.50, FOREIGN $6.00
Single copies, 50c

Entered as second-class matter, February 20, 1924, at the post office at Minneapolis 2, Minnesota, under the Act of March 3, 1879.
Established 1924

A POPULAR PRICED FRAME OF *Villadium*

LIGHT WEIGHT • NON-CORROSIVE • RUGGED • BODY ACID RESISTING



Villaire
Cat. No. 2052-21
Drop Eye
Solid Villadium
Non-tarnishable

Previous to the war, the Villaire in Villadium was one of the most popular, profitable and satisfactory of inexpensive frames. Dropped temporarily due to the non-availability of metal, it is back again, ready to give the same kind of hard wear service.

★ Some people find quality gold-filled frames beyond their means. Yet these same persons want wear and service from any economical frame. An inexpensive Villadium metal frame will serve much more satisfactorily than a cheap gold-filled.

The VILLAIRE is a pleasing example of Villadium design. It is clean-cut, sturdy and fits well. Its color is attractive and permanent. It is distinctive and dependable. For clinical work and for children, it knows no peer.

The Simplicity of Design is this frame's most attractive feature

Continental INDIANAPOLIS

AMERICAN ACADEMY OF OPTOMETRY

Dr. J. Fred Andreae, *President*
Baltimore, Md.

Dr. Harold M. Fisher, *Vice-President*
New York, N. Y.

Dr. Carel C. Koch, *Secretary*
Minneapolis, Minn.

EXECUTIVE COUNCIL

Dr. J. Fred Andreae, *Chairman*
Baltimore, Md.

Dr. Harold M. Fisher, *Vice-Chairman*
New York, N. Y.

Dr. Carel C. Koch, *Secretary*
Minneapolis, Minn.

Dr. Arthur P. Wheelock, *Past President*
Des Moines, Iowa

Dr. Robert E. Bannon
Hanover, N. H.

Dr. W. Edward Dewey
Battle Creek, Mich.

Dr. D. G. Hummel
Cleveland, Ohio

Dr. E. A. Hutchinson
Los Angeles, Calif.

Office: American Academy of Optometry: 1502 Foshay Tower, Minneapolis 2, Minn.

The AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY serves as the official publication of the American Academy of Optometry. It is published monthly by the American Journal of Optometry Publishing Association under the editorial supervision of the American Academy of Optometry.

Publication Office: 1502 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

AMERICAN JOURNAL OF OPTOMETRY *and* ARCHIVES *of* AMERICAN ACADEMY OF OPTOMETRY

VOL. 23 — No. 10

CONTENTS

ORIGINAL PAPERS

Accommodative Convergence in Squinters. H. W. Hofstetter 417

The After Effect of Lateral Duction Testing on Subsequent Phoria Measurements. Mathew Alpern 442

EDITORIALS

Visual Problems of Senior High School Students. J. G. Goodsell 448

TRANSACTIONS OF THE ACADEMY

Program of Annual Meeting at Philadelphia 451

Iowa Chapter—Fall Meeting 455

SPECIAL REPORTS

The Present Situation and the Prospects for the Immediate Future of the Los Angeles School of Optometry with some Personal Comment on Optometric Education in Its Larger Aspects. Ernest Hutchinson 456

The Cantonnet System From the Viewpoint of General Psychology. Eric Bateman 458

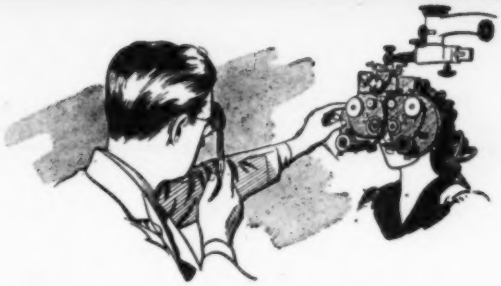
ANNOUNCEMENTS 462

What is "THERMAL COEFFICIENT O

Measurement of fusion strain—both amount and direction—is made by the Babinet Compensator, here operated by a Glass Plant Laboratory technician. In the experimental sample section above, a considerable strain, due to poorly matched rates of thermal expansion in the two types of glass, is revealed by the sharp bending of the shadowy vertical lines at the fused surfaces.

In this sample, the two types of glass fused together show a much better matching of thermal expansion characteristics—a smaller amount of strain is indicated by the smaller amount of displacement of the vertical lines. Glass for Bausch & Lomb fused bifocals must fall within a narrow limit of error in this fusion strain test.

Optical Quality Begins With Glass Quality



OF EXPANSION" to a Presbyope?

● In the production of fused bifocals, an accurately surfaced and polished segment "button" is placed on a matching "countersink" in the major lens blank, and the pair heated until the softening point of one of them is reached, when the two fuse.

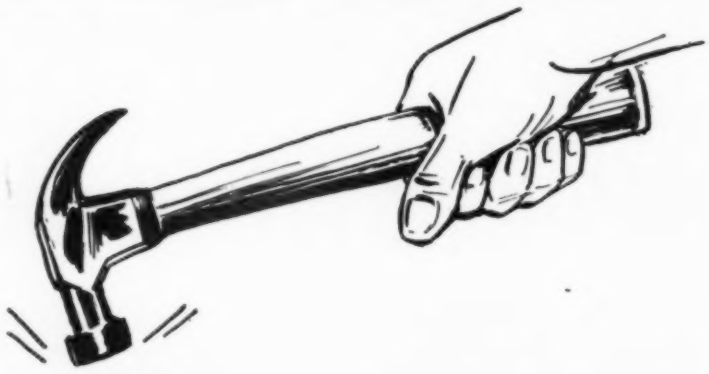
Both pieces expand when they are heated, and contract as they cool. But they are dissimilar in chemical composition, due to the requirement for their different refractive indices. And a difference in chemical composition is very likely to mean a difference in the rate and amount of that thermal expansion. Unless the softening point and the thermal expansion of the two pieces are carefully controlled and perfectly balanced, the fused joint will cool with strain introduced in one of the pieces of glass, strain that will render the lens useless.

So it's not enough, in making usable optical glass, to produce crystal-clear, strain-free, striae-free, bubble-free glass, critically controlled in its refractive index and dispersion characteristics. For fused bifocals, all of these properties must be maintained, and with them a critical control of softening point (without distortion) and thermal coefficient of expansion. And each batch, melt after melt, must come out with all these properties the same.

That's the kind of work Bausch & Lomb glass technicians have been pioneering for 34 years. Their achievement is glass for lenses that merit your highest professional confidence. Bausch & Lomb Optical Co., Rochester 2, N. Y.

BAUSCH & LOMB

ESTABLISHED 1853



When you hammer away year after year, at making just one thing–

LENSES

they've got to be GOOD

Titmus Optical Company

TITMUS OPTICAL CO. PERFEX PETERSBURG VA. U.S.A.

1908 · LENSES WORTHY OF THEIR NAME · 1946

ART-CRAFT ANSWERS THE FITTING PROBLEM

FOR *Miss S. L. G.*

She's young . . . she's lovely! Treasured secretary of a business tycoon, she "gets around" socially. She finds ART-CRAFT'S *Art-Bilt* Rimway Ful-Vue the ideal eyewear, for its graceful medium-height bridge exactly suits her features, while its inbuilt strength-without-weight means comfortable visual protection at all times. ¶ Just as *Art-Bilt* solves her fitting problem, there's an ART-CRAFT style to solve every one of yours, too.

Artcraft

ART-CRAFT OPTICAL COMPANY
ROCHESTER 6, NEW YORK

BAY STATE'S NEW

ROYAL AMBER

the crowning glory in zyl!

ROYAL AMBER? A totally different, rich, subtle color that has magic in its possibilities for blending with the wearer's coloring and costume. A warm yellow . . . a touch of royal purple . . . combine to produce this fascinating amber hue.

ROYAL AMBER zyl cannot be described in words nor illustrated in color; you must see it to realize its beauty and adaptability. Definitely dark—its flawless, distilled clearness, filled with gay highlights, appeals equally to feminine and masculine tastes.

Prescribe Royal Amber and your patients' zyl eyewear will become an exciting new accessory.

Supplied for the present in these four popular models:

See these frames in ROYAL AMBER at your supply house, or ask your suppliers' representatives to show you sample frames in ROYAL AMBER.

Royal Amber was developed for

BAY STATE OPTICAL COMPANY

ATTLEBORO, MASSACHUSETTS, U.S.A.

Traditional Craftsmanship Since 1862

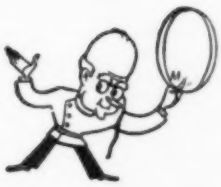
Chicago: 29 East Madison Street
Canada:
Imperial Optical Co.; National Optical Co.

Therminon Shows the "Stop" Sign to Infra-Red Rays

Therminon Lenses act as a filter and take out infra-red rays often considered harmful and the probable cause of some eye cataracts.

Therminon Gives the "Go" Sign to Visible Radiations

Therminon lenses allow the colors of the spectrum to pass in balanced proportion, the important visible light which is used for seeing.



Therminon's Popularity is Growing Rapidly

Therminon lenses can be worn day or night without reducing vision. Investigate what this greater visibility yet high absorptive lens can mean to comfort, satisfaction and greater seeing efficiency of your patients.

There's BENEFIT IN BETTER FIT . . . with THERMINON

THERMINON LENS CORPORATION

MANUFACTURERS OF THERMINON . . . AND OTHER FINE OPHTHALMIC LENSES

63rd & UNIVERSITY AVE. DES MOINES 11, IOWA

FEINCONE CONTACT LENSES

TANGENT CONE SERIES . . . . . NO MOLDING

SCHEDULED INSTRUCTION COURSES IN FITTING TECHNIQUE

(Courses Given Simultaneously in Three Cities on Dates Indicated)

Oct. 27-28-29	Savanna, Ga.	Denver, Colo.	New York (day)
Nov. 3-4-5	Birmingham, Ala.	Spokane, Wash.	— — — — — — — —
Nov. 10-11-12	— — — — —	San Francisco, Calif.	New York (5 evenings)
Nov. 17-18-19	Louisville, Ky.	Los Angeles, Calif.	— — — — — — — —
Nov. 24-25-26	Pittsburgh, Pa.	Tulsa, Okla.	New York (day)
Dec. 1-2-3	Detroit, Mich.	Houston, Texas	— — — — — — — —
Dec. 8-9-10	Chicago, Ill.	Washington, D. C.	New York (5 evenings)
Dec. 15-16-17	Syracuse, N. Y.	Philadelphia, Pa.	New York (day)

Parkersburg, W. Va. Nov. 11-12-13

"Veterans eligible under G. I. Bill"

Limited registration for each course . . . Confirmed in the order received. Additional information on request!

—Patients fitted from Standard Trial Set of 20 Lenses—

Regular Rx orders filled in 8 days . . . Special Rush Orders in 48 hours!

FIENBLOOM CONTACT LENSES, INC.

20 NORFOLK STREET NEW YORK 2, N. Y.

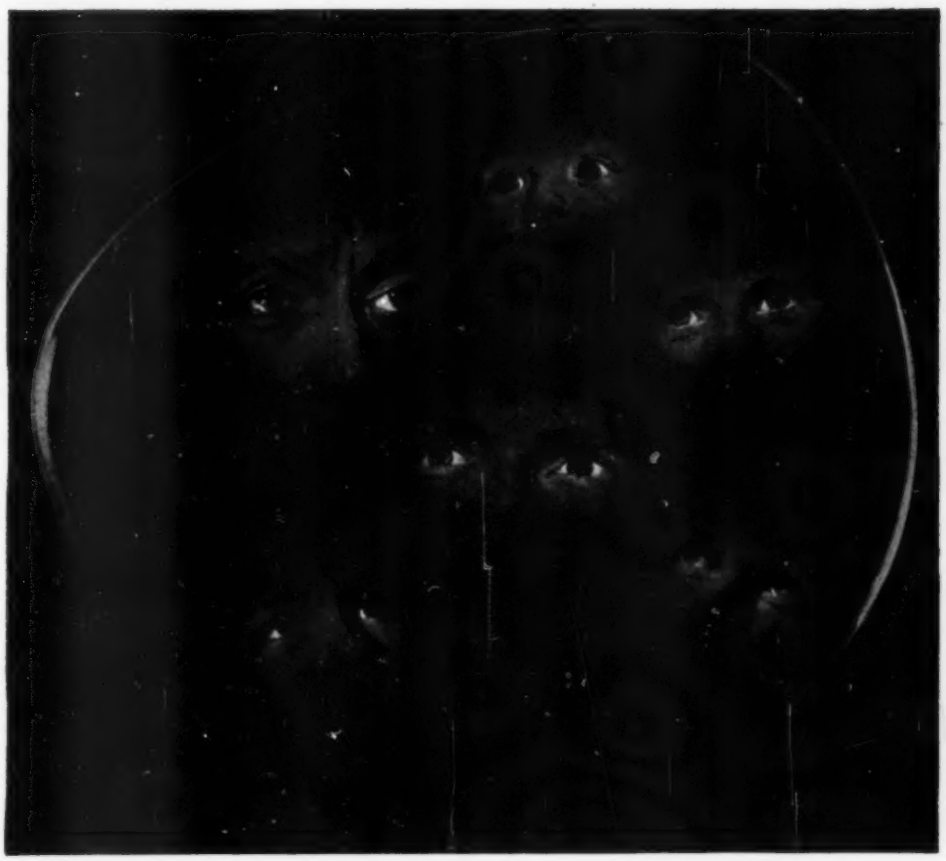
Smart men know that good grooming depends on every detail of their appearance. Naturally, they, too, want frames that flatter their individual personalities and preferences. Century combines science and style in precision-made frames that dre designed to every demand—distinctive, conservative, or tailored — so that you can please all your patients by recommending the right frame from CENTURY'S comprehensive collection.

Century

OXFORD MANUFACTURING CORP.

200 60th STREET, BROOKLYN 20, N. Y.

This Advertisement Speaks Volumes!



Copyright 1948, Better Vision Institute, Inc.

To Each—one pair of EYES to last a lifetime

YOUR QUOTA FOR A WORLD OF VISION: *One Pair of Eyes.* One pair of eyes for *seeing:* the stars, the city lights; the sunrise and sunset; the budding of trees, the faces of children . . . One pair of eyes for *reading:* the books of the masters, the news of the day; the history, science and learning of man . . . One pair of eyes for *working:* at figures or at letters, with tools or machines, on farm or at forge . . .

And one pair of eyes for *surviving:* the dangers of the highway, the hazards at home, the everyday perils that lie in your path.

Guard those eyes—they are priceless! Surely—surely, they are deserving of considerate care. They work so hard to meet every new strain, taxing nerve and muscle to the limit. And they change, inevitably, with age. Clearly, those miraculous eyes are worth a little of your time in a lifetime that would be so handicapped without them!

Modern Science can protect your eyes, can improve your seeing, can correct the eye changes of age. The professional knowledge of your Ophthalmologist and Optometrist, and the skills of your Ophthalmic Dispenser (Optician) are preventive almost as often as they are corrective. Call upon their help now. You owe your one pair of eyes that much!

BETTER VISION INSTITUTE, INC., 630 Fifth Ave., New York 20, N. Y.

BETTER VISION FOR BETTER LIVING

Compressed into one vivid, unforgettable page, this story of eyes speaks volumes!...Its warm entreaty will be taken to heart by the 40 million readers of BVI's inspiring series of messages in Life, Saturday Evening Post, Ladies' Home Journal, American, Farm Journal, Hygeia and MacLean's. To the 3700 members who support the Institute's good fight for better vision: *supreme credit!* BETTER VISION INSTITUTE, Inc., 630 FIFTH AVENUE, NEW YORK 20, N. Y.

The Need for Education Never Ends

BVI

Here's PROOF that A-O *Cruxite* is NON-FADING

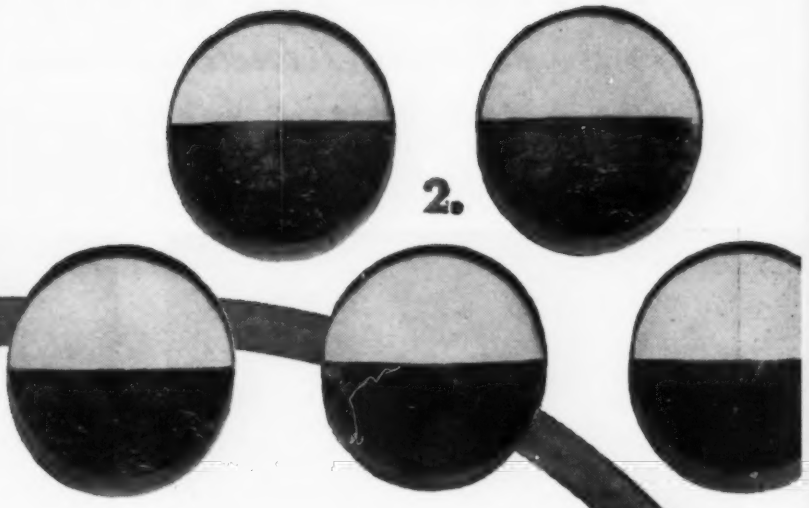
To make sure that you do not have to contend with fading in your absorptive lens prescriptions (faded lenses are difficult to match in case of replacement), A-O Cruxite lenses are periodically subjected to gruelling solarization tests. In these tests conducted by both A-O and impartial laboratories,* here's what happens.

1. *Stock samples are selected at random to undergo fade tests.*
2. *Lenses are prepared for testing by wrapping lower halves in protective lead foil.*
3. *Lenses are exposed to intense ultraviolet radiations for 100 hours. This exposure is the equivalent of a year in direct sunlight. (As an additional check on Cruxite's non-fading quality, lenses are subjected to the rigors of actual light and weather by roof-top exposure for a year.)*
4. *When the foil is removed, the unprotected and protected sections of the lenses are exactly the same color.* ***This proves that A-O Cruxite does not fade!***

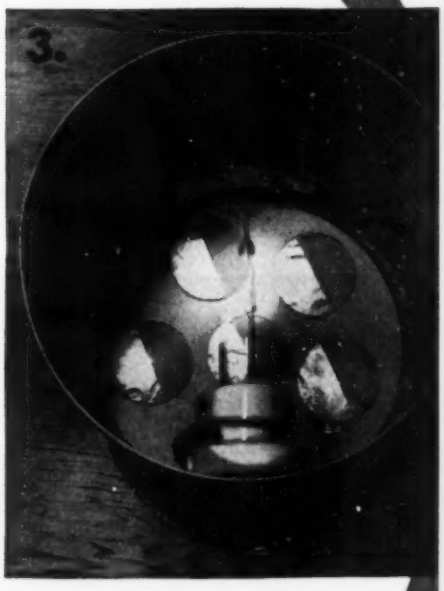
Whenever refractions indicate the need of absorptive lenses, you can be sure of color and absorptive constancy by prescribing A-O Cruxite. For your convenience and adaptation Tillyer single vision and bifocal lenses are available in Cruxite in two shades—A, light; AX, medium.

**Electrical Testing Laboratories, New York, N. Y.*

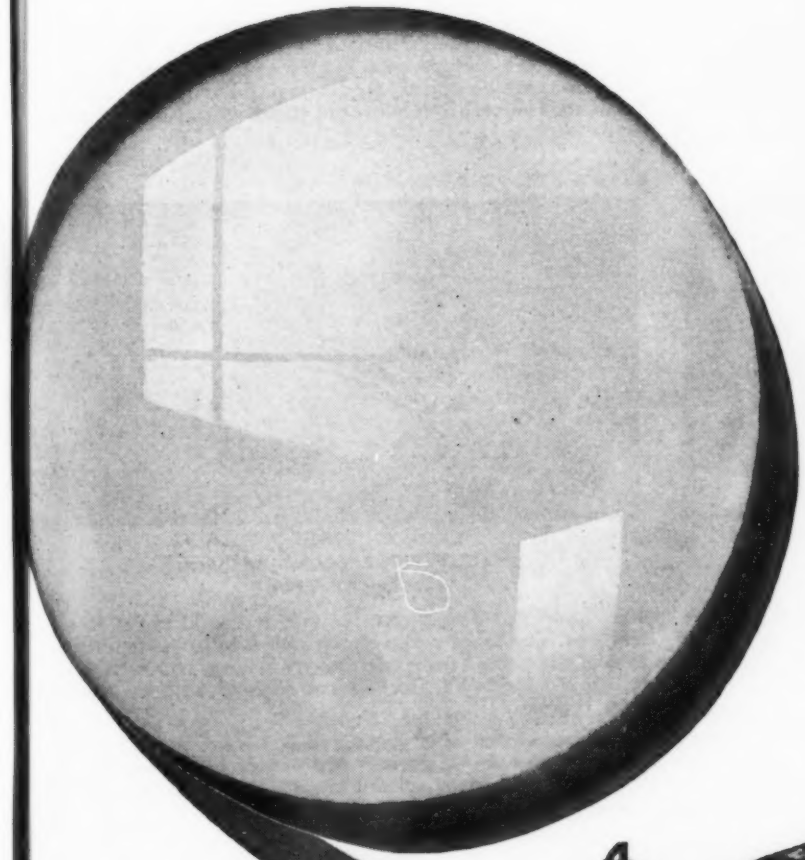
American Optical
COMPANY



2.



3.



4.

A Frame for Every School Age

From Kindergarten to College

A frame to fit your patients' needs, regardless of school age. Frames for the rough and ready boy who goes in for school sports—frames for the fashion-wise coed that will win the favor of her fellow students—frames that will serve as sound practice builders.

BAUSCH & LOMB JAUNTEE IN FUL-VUE FOR THE JUNIOR MISS
(Catalog No. 3B21P21)

The "frame with a flare" designed to appeal to feminine tastes, young and old — fashioned in the graceful upsweep without sacrificing optical performance, this modern style frame gives a wide, normal field of vision. The Jauntee is finished in a rich, high polish produced by a series of carefully-controlled hand-polishing operations—properly positioned endpieces—preformed temples and fronts—undercut bridge for comfortable, snug fit—a highly desirable frame to fill the needs of the Junior Miss who demands style plus performance.

THE RODEO FRAME FOR BOYS
(Catalog No. B696E1140)

The Rodeo frame is strongly built to stand up under hard wear. Bridge reinforcements ingeniously hidden behind eye wires give Rodeo extra strength and rigidity.
Rodeo's rugged eye wires are distinctively engraved. Front edges are beaded to break up reflections. Heavier pad arms are a feature of Rodeo construction. High Ful-Vue temples add to Rodeo's popularity. Here's a frame that meets all demands of the young, rough-and-ready patient.

WINGER FOR BETTY COED
(Catalog No. W3)

Wingers are an endorsement for the modern practice of fitting optical frames with an eye for beauty. The Betty Coed who wears this frame will receive hearty applause from her classmates.

ZYL FUL-VUE FOR YOUNG PATIENTS
(Catalog No. F144)

The F144 Ful-Vue frame is designed to fit children's features. The low bridge construction follows the contour of the child's nose and assures a snug, comfortable fitting. An added feature is the stiff riding bow, wire core temples.

Prescribe Roco Saferex lenses, the scientifically hardened lenses that offer greater resistance to those elements causing the usual lens breakage. Roco Saferex lenses afford greater eye protection, plus correction for your patients, young and old. For the rough-and-ready school child. Roco Saferex lenses mounted in a sturdy frame is a happy combination.

Riggs Optical Company

Distributors of Bausch & Lomb Ophthalmic Products

General Offices: Chicago, San Francisco • Branches in Principal Western and Mid-Western Cities

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Vol. 23 OCTOBER, 1946 No. 10

ACCOMMODATIVE CONVERGENCE IN SQUINTERS*

H. W. Hofstetter†
School of Optometry
The Ohio State University
Columbus, Ohio

In a previous paper[1] the author has presented in some detail a history of the investigations that have been made on the relationship between accommodation and convergence. Many of the difficulties encountered in the analysis of the relationships demonstrated in these investigations can be attributed to the failure to consider the normal convergence of the two eyes as a composite of several separately demonstrable components. This method of analysis, originally described by Maddox[2], assumes at least three sources, or patterns, of convergence innervation which summate to produce the normal act of convergence of a normal pair of eyes. The three components given by Maddox are as follows:

1. *Tonic convergence*: This is the convergence attributable to the normal or basic tonus of the extra-ocular muscles.
2. *Accommodative convergence.*
3. *Reflex convergence*: Positive and negative fusional convergence.

It has been pointed out[3,4] that there are additional convergence factors which cannot readily be classified as belonging to one or another of the above categories but for the purposes of this study they can be regarded as constant factors in that they are demonstrated by techniques not involved in this investigation. Similarly, the first of the above mentioned types, tonic convergence, can be ruled out in the present analysis on the basis that it remains constant during the testing procedure. The reflex convergence is eliminated by using as subjects squinters who do not

*Read before the Twenty-second Annual Meeting of the American Academy of Optometry, on December 10, 1945, at Columbus, Ohio. For publication in the October, 1946, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Fellow of American Academy of Optometry.

to reciprocal innervation to convergence. (6) A limited amount of hyperopia forms the necessary area of compensation to protect the integrity of the pattern of focus. Likewise, a limited amount of exophoria forms the necessary area of compensation to protect the integrity of the pattern of triangulation. (7) From this basic approach it is reasoned that visual problems result from disharmony between the neural pattern of control of these two functions (patterns of focus and triangulation) in the central nervous system. (8) These disharmonies are basically brought on by "reading," where "reading" is broadly defined as any maintained, sustained, concentration within a restricted area of visual activity. (9) Visual concentration in a restricted area of movement is considered an artificial task. Any artificial task will cause a "shift" or even absorption of "slack" between patterns. In the latter case symptoms of discomfort arise. Thus, discomfort is often associated with undesirable phorias; hyperopia in excess of the amount needed to protect the integrity of accommodation; dis—equilibrium between patterns; the loss of visional skills. T. O. B.

---

12. MISCELLANEOUS

PRELIMINARY REPORT TO STUDY ADVANCEMENT OF OPTOMETRY IN INDIANA. Special Committee, Indiana Association of Optometrists. E. J. Cain, et al. Indiana Optometrist, 1944, 16, 7, 12-14.

The committee presents the following concepts as a basis for future study and agreement. (1) A profession has for its prime object the service it can render humanity and any remuneration or financial rewards must be a subordinate consideration. Since optometry is a profession, any individual practicing it must conduct himself in accordance with this tenet. (2) Any system of ethics and economics that seeks to distribute a profession's service on any other basis than the welfare of humanity invites the loss of that profession's right to survival. (3) There is a system of ethics and economics more than two thousand years old (slightly altered to meet contemporary conditions) by which the medical profession has survived and has been rewarded a peculiar position in society. It would be specious argument that differences in the functions of the two professions would mean that the infant profession of optometry could survive with any system of ethics and economics that varied greatly from that of medicine. (4) Because of its comparative youth and because of its origins, the profession of optometry must then lean on this heritage of medicine and base its own ethics and economics upon this historical material, altered in the light of optometry's peculiar function and not upon its peculiar origins. A. V. H.

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Vol. 23 OCTOBER, 1946 No. 10

ACCOMMODATIVE CONVERGENCE IN SQUINTERS*

H. W. Hofstetter†
School of Optometry
The Ohio State University
Columbus, Ohio

In a previous paper[1] the author has presented in some detail a history of the investigations that have been made on the relationship between accommodation and convergence. Many of the difficulties encountered in the analysis of the relationships demonstrated in these investigations can be attributed to the failure to consider the normal convergence of the two eyes as a composite of several separately demonstrable components. This method of analysis, originally described by Maddox[2], assumes at least three sources, or patterns, of convergence innervation which summate to produce the normal act of convergence of a normal pair of eyes. The three components given by Maddox are as follows:

1. *Tonic convergence*: This is the convergence attributable to the normal or basic tonus of the extra-ocular muscles.
2. *Accommodative convergence.*
3. *Reflex convergence*: Positive and negative fusional convergence.

It has been pointed out[3,4] that there are additional convergence factors which cannot readily be classified as belonging to one or another of the above categories but for the purposes of this study they can be regarded as constant factors in that they are demonstrated by techniques not involved in this investigation. Similarly, the first of the above mentioned types, tonic convergence, can be ruled out in the present analysis on the basis that it remains constant during the testing procedure. The reflex convergence is eliminated by using as subjects squinters who do not

*Read before the Twenty-second Annual Meeting of the American Academy of Optometry, on December 10, 1945, at Columbus, Ohio. For publication in the October, 1946, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Fellow of American Academy of Optometry.

demonstrate normal binocular fusion. The remaining component, accommodative convergence, is that with which this paper is specifically concerned.

Allusion to the fundamental nature of accommodative convergence was originally made by Donders in describing his accommodative theory of strabismus. Donders[5] presented statistics to show that hyperopes tended to be esotropes while myopes tended to be exotropes. His theory was that the additional accommodation necessary in hyperopia produced an overconvergence while the relaxation of accommodation in myopia produced an insufficiency of convergence. Obviously he assumed an unavoidable connection between accommodation and convergence which corresponds to the accommodative convergence in the present analysis.

The same connection in subjects capable of binocular fusion was illustrated by Donders[6] in his zones of clear single binocular vision by the fact that the zones demonstrated a shift of the range of relative convergence for different levels of accommodation.

A simple demonstration of the direct relationship between accommodation and convergence was described by Landolt.[7] It consists in observing the convergence of an occluded eye when accommodation is effected as a response to a concave lens placed in front of the other eye. This is a dissociation technique and to that extent corresponds to the clinical observation of changes in phorias brought on by changes in accommodation when lenses of various powers are inserted in the phorometer trial frame.

Landolt pointed out that the direct observation of the convergence brought on by accommodation cannot be used as evidence of a common center for the two functions. He believed that the relative range of each of the functions when the other was fixed identified them as of separate origin.

The objection to a common center is obviated, however, by Maddox's analysis of the components of convergence. His analysis would permit an absolute tie-up between accommodation and convergence, producing the component referred to as accommodative convergence. The balance of the required convergence innervation could then be considered to be supplied by the fusional centers.

That there may be anatomical connections within the oculomotor nuclei which would account for a simultaneous innervation to accommodation and convergence has been suggested by H. Hartridge[8]. His diagram of these nuclei includes association fibres connecting the centers controlling the internal recti with the centers controlling the ciliary muscles.

A number of authors have postulated that the relationship between

accommodation and convergence is learned. This belief is based primarily on the fact that the two functions normally operate quite synchronously in making successive fixations of objects at various distances. Constant repetition of such simultaneous activity is then assumed to result in a learned association. It is, of course, difficult to deny the possible effects that may be produced in this way when the problem is considered only in the light of the studies that have been made on subjects enjoying normal binocular vision.

The influence of learning is, however, eliminated as a factor in the problem by measuring the accommodative convergence as it exists in a pair of eyes that have never attained binocular vision. Any congenital defect, congenital cataract for example, which does not permit vision in one of the eyes, provides the desirable conditions for such an investigation.

Of almost equal value is the measurement of the accommodative convergence in life-long squinters. Although a crude form of binocular vision may be employed by many squinters it seems safe to say that any accommodative convergence that is present must be innate since the squinter first of all has had nothing to gain by its presence, and, secondly, he has had no opportunity to develop it by association.

It is also of interest to include in the problem an investigation of the accommodative convergence that exists in various types of cases in which binocular vision has not been in use for a considerable length of time. Such cases include cataracts from trauma, squint precipitated by a disease or injury, direct paralytic squint, and in fact all types of squint whether or not they are known to be congenital. If accommodative convergence depends upon the simultaneous use of the two functions the degree of relationship should be reduced, if not entirely absent, in such cases.

METHOD AND APPARATUS

Two types of apparatus were employed. Both represented special adaptations of the mirror haploscope. While they consisted of completely separate mechanical units, they differed fundamentally only in the manner in which the stimulus to accommodation was effected. By way of explanation it should be stated that the change in instruments during the course of investigation was a matter of convenience in the course of a more general investigation of which this paper represents a part.

The first of the two units is schematically represented in Fig. 1. A reduced Snellen target (A) is mounted on one arm of a mirror haploscope. The stimulus to accommodation is controlled by manipulating the distance of this target from the lens (F). A small light (B) and a peephole

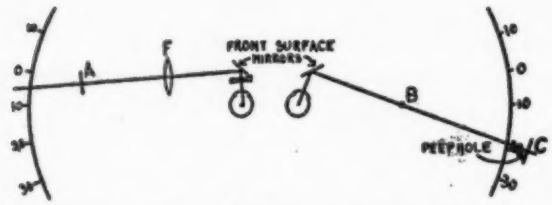


Fig. 1. DIAGRAM OF APPARATUS FOR MEASURING ACCOMMODATIVE CONVERGENCE.

(C) are mounted on the other arm of the haploscope. By observing the corneal image of the light (B) through the peephole (C) it is possible for the operator to locate the line of sight of the non-fixating eye and determine its direction for a given accommodation stimulus to the fixating eye.

The optical system on the left arm of the haploscope represents a Badel optometer system in that the secondary focal point of the system is made to lie at the entrance pupil of the left eye. This permits variations in the stimulus to accommodation without changes in the size of the visual angle subtended by the image seen by the left eye. The fixation target (A) is transilluminated and has a constant brightness. The arms of the haploscope rotate about independently adjustable pivots which are placed to correspond with the centers of rotation of the subject's eyes. The centers of rotation were assumed to lie 13 mm. behind the plane of the apex of the cornea. The separation of the haploscope pivots was considered to correspond to the separation of the centers of rotation of the eyes when changes in the direction of fixation, with the head fixed, showed the eyes to be in continuous alignment with the optical systems.

The degree of convergence or divergence of the two lines of sight was indicated by the relative positions of the pointers on the arc scales having their centers of curvature at the respective centers of rotation.

The line of sight of the left eye was considered to coincide with the axis of the optical system of the left arm of the haploscope when the subject was fixating a centrally located letter on the reduced Snellen chart. The line of sight of the right eye was considered to be coincident with the axis of a system of apertures on the right arm of the haploscope when the pupil appeared centered with respect to these apertures while the corneal reflex of the source (B) was seen about one-half millimeter nasal to the center of the pupil.

The angle of convergence measured for each of several degrees of

stimulus to accommodation was recorded and plotted on a graph, Fig. 7A being a group of such graphs. Each small circle in the figure represents a single measurement.

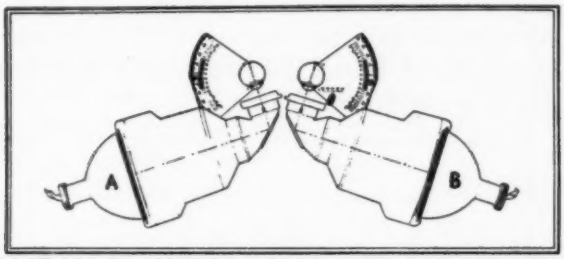


Fig. 2. DIAGRAM OF SYNOPTISCOPE USED FOR MEASURING ACCOMMODATIVE CONVERGENCE. Figure adapted from illustration in Synoptiscope manual.[9]

In order to determine the adequacy of the stimulus to accommodation, the actual accommodation was measured in the case of H.H. (Fig. 7A). For this purpose an auxiliary device for measuring the actual accommodation in play at a given moment was provided on the left arm of the haploscope. This device, described in previous papers,[1,8] is a bi-prism

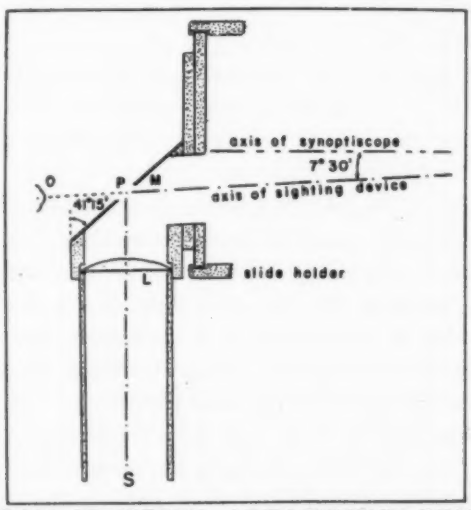


Fig. 3. DIAGRAM OF SPECIAL ATTACHMENT DESIGNED FOR USE WITH THE SYNOPTISCOPE.

arrangement for projecting into the left eye two narrow beams of light which are seen by the subject as two vertically aligned slits when the plane of the bi-prism is at the conjugate focus of the retina. The adjust-

ment of this was made by the subject while he fixated the letters. The amount of accommodation of the left eye and the relative positions of the lines of sight of the two eyes were then simultaneously determined for each given stimulus to accommodation. The stimulus to accommodation was successively increased and decreased until the originally readable letters became blurred. Fig. 4 shows the accommodative response measured for each amount of accommodation stimulus.

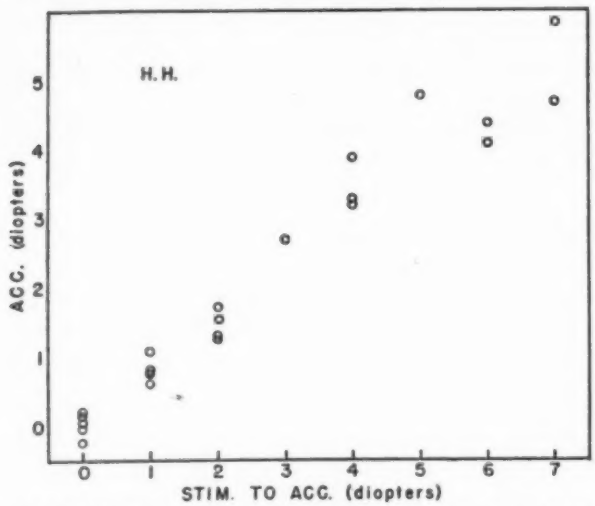


Fig. 4. ACCOMMODATIVE RESPONSE ELICITED BY THE HAPLOSCOPE FIXATION CHART.

It was observed (Fig. 4) that the major discrepancies existed only at the greater amounts of stimulus to accommodation at which amounts the subject reported blurring. It was therefore considered sufficiently adequate for the purpose of this investigation to plot the convergence against the stimulus to accommodation so long as the stimulus was not increased or decreased beyond the limits at which blurredness could not be overcome. The actual error that was produced in the case of H.H. in making this assumption may be seen by comparing graphs H.H.-1 and H.H.-2 in Fig. 7A. In H.H.-1 the convergence is plotted against the measured accommodation and in H.H.-2 against the stimulus to accommodation.

The second of the two sets of apparatus used in this investigation is schematically represented in Figs. 2 and 3. The unit consists of a Synoptiscope with a specially designed attachment for observing the corneal reflex. Fig. 2, adapted from a figure in the Synoptiscope manual,[9]

illustrates the principle of this instrument. One of the lamp housings (A or B) is removed and replaced by the attachment illustrated in Fig. 3. The combination of a light source (S), a collimating lens (L), and front surface mirror (M) with a peephole (P) directs a hollowed cylindrical beam of light into the eye of the subject looking into the Synoptiscope. This light is seen by the subject as a bright annulus of light around a dark aperture. At the same time the corneal image of the annulus can be seen by the observer (O) looking into the peephole. By observing the position of the corneal reflex with respect to the center of the pupil it is possible for the operator to determine very accurately the position of the Synoptiscope tube which will place the center of the annulus on the subject's line of sight. The axis of the sighting system is tilted 7½° with respect to the axis of the Synoptiscope tube to avoid the interference of reflections from the Synoptiscope lens with the observation of the corneal image. Correction for the 7½° tilt is then made in the scale reading of the Synoptiscope.

The stimulus to accommodation was controlled by the use of auxiliary lenses in front of the fixating eye. A transilluminated slide of a reduced Snellen chart inserted in front of one of the lamp housings (A or B) provided a fixation target. As in the case of the first instrument, adjustments were made to place the pivots of the rotating arms of the Synoptiscope at the centers of rotation of the two eyes, the instrument being likewise adjustable for various separations of the ocular centers of rotation.

The method of controlling the stimulus to accommodation in the latter instrument differed from the former in that the lens system did not represent a Badel system. Hence, as auxiliary minus lenses were added to increase the stimulus to accommodation the apparent size of the image of the Snellen letters was decreased so that an uninformed observer might assume that the originally just readable letters were becoming blurred when in fact they were becoming too small to be resolved. However, by changing the fixation to slightly larger letters on the Snellen scale at fixed dioptric intervals and by explaining to the subject the differentiation to be made between letters too small and letters too blurred this handicap was, in the opinion of the writer, quite adequately overcome.

Although no formal investigation was made of the degree of correlation of measurements obtained with the two instruments, it was observed in a number of subjects that the two instruments produced essentially identical results. The same observation procedure was employed for both instruments.

DESCRIPTION OF SUBJECTS

The subjects in this investigation were obtained from the eye clinic of the Ohio State University School of Optometry. Each subject wore his best distance correction during the tests.

The following descriptions include the subject's initials, sex, age, Rx, acuity, diagnosis, and facts in the case history that gave some indication as to the duration of the anomaly.

H.H., man, age 34

Rx. O.D. none specified. V.A. total blindness.
O.S. —.50 —.25 × 60 V.A. 20/20

Congenital cataract in the right eye.

P.M., man, age 19

Rx. (not recorded)
V.A. O.D. 20/20
O.S. Brightness only. Lost fixation.

Corneal opacities in the left eye. Low acuity noted in early infancy. Attendant circumstances not known. Fundus appears normal.

W.H., man, age 23

Rx. O.D. + 2.00 —.50 × 180 V.A. 20/20
O.S. none provided. V.A. total blindness.

Cataract in left eye from injury 3½ years previous. No evidence of paralysis. No unusual muscle imbalance noted previous to injury.

M.R., woman, age 19

Rx. O.D. — 1.50 sph. V.A. 20/20
O.S. —1.25 —.25 × 90 V.A. 20/20

Alternating intermittent concomitant esotropia with small central suppression in the non-fixating eye. Occasional indications of functional anomalous correspondence. Squint first observed during the routine refraction.

H.S., woman, age 22

Rx. O.D. +4.25 —2.25 × 180 V.A. 20/20
O.S. +4.00 —1.50 × 5 V.A. 20/20

Alternating concomitant esotropia with functional anomalous correspondence. Squint first observed at age of 3 following flu.

M.B., girl, age 12

Rx. (at age of 4) O.D. +3.50 —2.00 × 180 V.A. 20/50
O.S. +2.50 sph. V.A. 20/25
Rx. (at age of 12) O.D. +3.25 —.75 × 180 V.A. 20/20
O.S. +3.50 —.75 × 180 V.A. 20/20

Alternating concomitant squint, exotropic at distance and esotropic at near. An operation at 3 years of age to correct squint. The factor preventing normal binocular vision remains undetermined. Occasional clinical observations over a period of 9 years verify the continuous existence of squint.

C.R., man, age 19

Rx. O.D. +2.50 sph. V.A. 20/20
O.S. +2.50 —1.25 × 180 V.A. 20/200

Monolateral concomitant esotropia and central suppression of left eye. Squint dates as far back as the subject can remember.

D.F., man, age 19

Rx. O.D. +2.00 sph. V.A. 20/16
O.S. +4.00 —1.25 × 185 V.A. 20/65

Monolateral concomitant esotropia with amblyopic left eye and anomalous retinal correspondence. Squint first observed at age of 8. Attendant circumstances not known.

N.M., boy, age 15

Rx. O.D. +.50 sph. V.A. 20/15
O.S. +1.25 sph. V.A. 20/50

Monolateral concomitant esotropia with amblyopic left eye. Parents believe squint first appeared 4 or 5 years ago. Two operations about 3 years ago. Two sisters squint.

P.S., boy, age 13

Rx. O.D. +4.00 sph. V.A. 20/25
O.S. +6.00 sph. V.A. 20/70
V.A. without Rx. O.D. 20/25
O.S. 20/80

Monolateral concomitant esotropia with amblyopia and a 1° —5° temporal paracentral suppression area in the left eye. No glasses worn until age of 12½. School work excellent. Squint first observed in the routine refraction. It is the writer's opinion that the squint dates to earliest infancy.

J.M., man, age 19

Rx. O.D. +1.37 —.50 × 25 V.A. 20/20
O.S. +1.12 — .37 × 165 V.A. 20/20

Alternating concomitant exotropia with anomalous retinal correspondence. Squint first observed at about 5 years of age. Onset associated with some childhood disease, probably measles.

M.G., woman, age 20

Rx. O.D. —4.25 sph. V.A. 20/20
O.S. —6.75 —.25 × 90 V.A. 20/20

Alternating periodic exotropia (i.e., squints only at near). Subject had not been aware that her eyes failed to converge for near work. No diplopia could be elicited in the near point of convergence test. Three months of base-out prism training showed no improvement in the ductions.

B.M., girl, age 16

Rx. O.D. +.50 —.50 × 90 V.A. 20/20
O.S. +.50 — .50 × 90 V.A. 20/20

Intermittent alternating concomitant exotropia. Squint appeared before the age of 5. Onset is associated with rickets in early infancy. Muscle operation at age of 6. A brother and a sister both squint.

A.T., girl, age 16

Rx. O.D. +.50 sph. V.A. 20/20
O.S. +.50 sph. V.A. 20/33

Monolateral concomitant exotropia with functional anomalous correspondence and amblyopic left eye. Squint was known to exist during past few years. A brother squints.

G.A., man, age 33

Rx. O.D. —1.50 sph. V.A. 20/20
O.S. —1.00 cyl. × 175 V.A. 20/20

Partial IIIrd nerve paralysis from skull fracture 3½ years ago. Early complaint was diplopia. Has learned suppression for ordinary seeing, but still obtains an annoying diplopia at eccentric directions of fixation. Monocular amplitudes of accommodation normal, light reflexes normal, left pupil larger than right, and left eye deviates down and to the left.

M.M., girl, age 13

Rx. O.D. —.37 × 90 V.A. 20/13
O.S. —.12 × 90 V.A. 20/13

Normal correspondence. With effort can get binocular vision at near. Monolateral exotropia, vision in right eye suppressed. Duration of squint unknown.

M.K., man, age 18

Rx. O.D. +1.25 —.25 × 60 V.A. 20/15
O.S. +1.50 —.25 × 150 V.A. 20/15

Parents report the observation of squint before age of 3 or 4.

Monocular versions normal. Can fixate voluntarily with either eye but ordinarily fixates with left.

S.F., man, age 26

Rx.	O.D. +6.00	V.A. 20/200
	O.S. +5.75 —.75 × 40	V.A. 20/15

Monolateral esotropia. Date of onset believed to be at birth.

B.G., woman, age 26

Rx.	O.D. +1.00	V.A. 20/20
	O.S. + .75	V.A. 20/20

Alternating exotropia. Date of onset known to be very early in life.

S.L., man, age 19

Rx.	O.D. —.25	V.A. 20/15
	O.S. —.25	V.A. 20/20

Subject was not aware of squint until informed at time of examination. Case history of no value in establishing date of onset. Uses right eye alone almost constantly. Has difficulty guiding himself in straight line when right eye is occluded. Can fixate with left eye only when right eye is occluded. Routine 6 M. phoria test showed 19 △ exo.

M.Br., man, age 20

Rx.	O.D. +.50	V.A. 20/15
	O.S. +.50	V.A. 20/15

Muscle operation on left eye to correct tropia at age of 10. Nature of previous squint not known. Subjective 6 M. phoria showed 11 △ eso. Squint alternating. Right hypertropia approximately 12 △. After-image test shows anomalous correspondence.

B.H., man, age 20

Rx.	O.D. +1.00 —1.00 × 8	V.A. 20/16
	O.S. + .50 —1.75 × 8	V.A. 20/16

Alternating exotropia. Anomalous correspondence. Has worn glasses since 3 years of age. Squint believed congenital. Observed at 3 years.

R.H., man, age 19

Rx.	O.D. + .75	V.A. 20/20
	O.S. +1.00	V.A. 20/15

Severe occipital head injury at age of 3. Subsequently convergent squint was observed by parents. Uses left eye only, except when fixating toward extreme left. Definite anomalous correspondence. Monocular fixation fields show normal limitations.

R.S., boy, age 12

Rx. O.D. plano V.A. 20/15
O.S. plano V.A. 20/400 (pin hole 20/400)

No paralysis evident. Lost-fixation in left eye. Ophthalmoscope and retinoscope show little if any ametropia. Previous examiner reports existence of squint at first examination at age of 6.

R.F., man, age 18

Rx. O.D. plano V.A. 20/20
O.S. plano V.A. 20/400

Left hypertropia, pronounced. Left eye shows rapid small vertical nystagmus. Left eye shows false fixation. Blind spot at about ½ normal distance from point of fixation. Muscle operation at 8 years. Cousin's eyes crossed.

V.H., girl, age 5½

Rx. O.D. +.75 —.37 × 180 V.A. 20/50
O.S. +.75 —.37 × 180 V.A. 20/33

Anomalous correspondence easily demonstrated. Internal squint first noticed at 4 months. Prolonged monocular atropinization employed at 6 months. Muscle operation at 4½ years. Alternates fixations.

L.B., boy, age 12

Rx. O.D. +.50 V.A. 20/20
O.S. +.50 V.A. 20/20

Parents report observation of squint immediately after birth. Exotropia increases upon looking up. Fixations alternate. Normal correspondence indicated by phoria tests. Normal limitations in monocular versions.

RESULTS:

The graphs in Figs. 7 (A, B, C, and D) indicate a direct linear relationship between accommodation and accommodative convergence. On the assumption that this relationship is linear, the line of regression[10] was statistically computed for each graph using the stimulus to accommodation as the controlled variable and accommodative convergence as a function of the variable. Each graph includes its computed line of regression.

The slope* of this line can be used to express the ratio of accom-

*The slope of a line is usually defined as the ratio of the difference between the ordinate values of two points in the line to the difference between their abscissa values. However, because of the customary method of plotting accommodation and convergence, it is more convenient here to designate slope as the ratio of the abscissa to the ordinate, i.e., the convergence to the accommodation.

modative convergence to accommodation. This ratio is conveniently called the ACA ratio. The ACA ratio expresses the number of centrads of convergence produced by one diopter of accommodation.

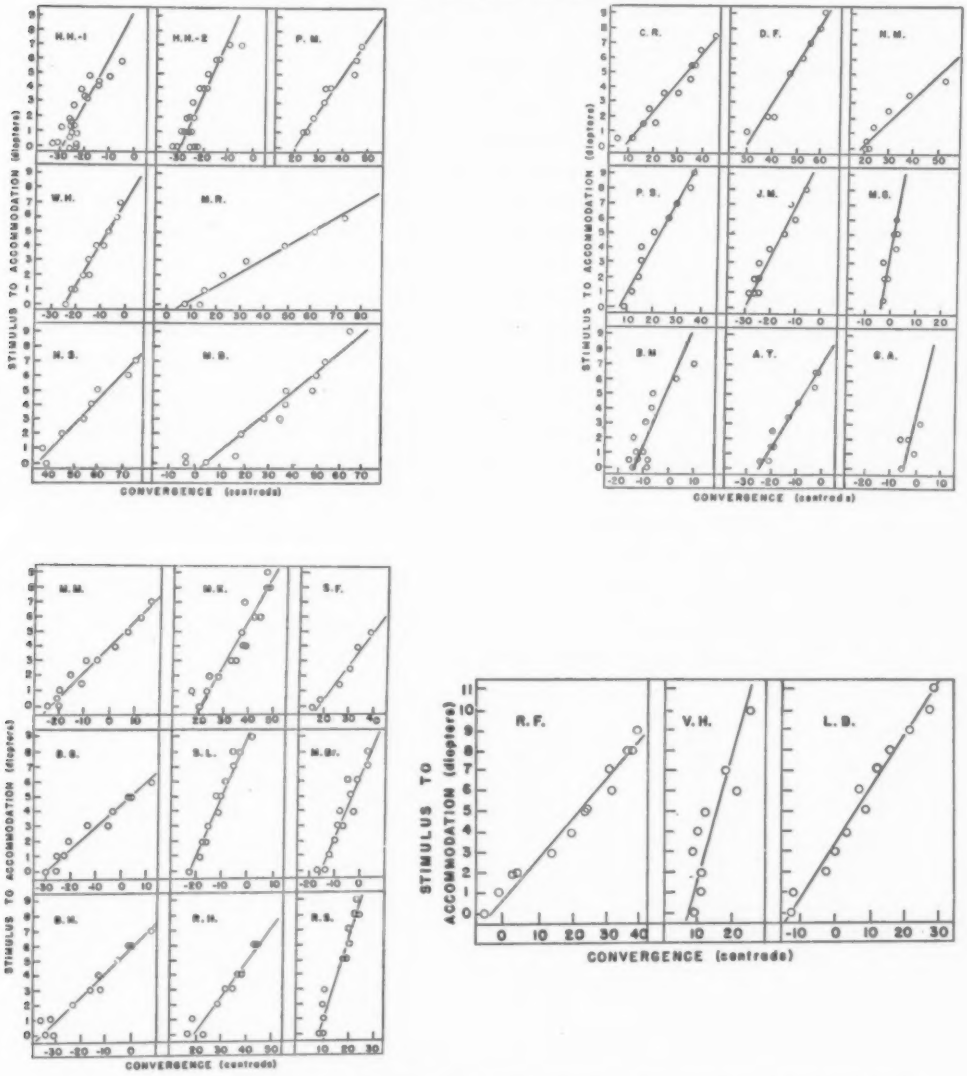


Fig. 7. (A, B, C, and D) THE RELATIONSHIP OF CONVERGENCE TO ACCOMMODATION IN TWENTY-SEVEN SUBJECTS.

The zero value of convergence represents the parallel position of the lines of sight. The positive values represent convergence (esotropia) and the negative values represent divergence (exotropia). The letters identify the subject.

The point at which the line of regression intersects the line representing the zero level of accommodation gives a theoretical value for the deviation of the eyes from parallelism when the accommodation is relaxed. In squint this would be the theoretical distance tropia and in binocular vision this would be the distance phoria. This provides a useful means of designating the angle of squint.

The duration of the squint was not determined accurately in some of the cases, so that, for the purpose of tabulation, it becomes necessary to state both the maximum and minimum possible number of years that the squint existed. When the onset of the squint is not known the maximum possible duration is the age of the patient. The minimum possible duration, on the other hand, is the number of years since it was first observed. Thus the minimum duration in the case of M. R. is zero, since the squint was first discovered in the routine eye examination made at the time of this investigation. In several instances the squints were discovered in eye examinations made at some known time previous to this investigation, as in the case of M. G. In instances in which the squint existed longer than the subject could remember, the minimum duration was arbitrarily set at some value which seemed reasonable to both the subject and the examiner. Thus, in the case of C. R. the minimum duration was set at 10 years.

The data in terms of the duration of anomaly, the theoretical angle of deviation, and the ACA ratio are summarized in Table 1. The

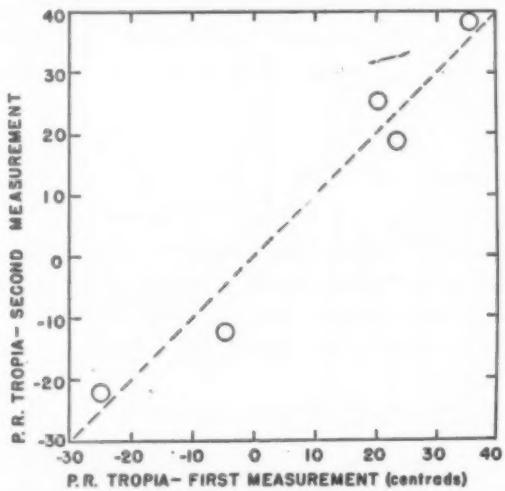


Fig. 5. COMPARISON OF FIRST AND SECOND MEASUREMENTS OF THE ANGLE OF SQUINT OF FIVE SUBJECTS.

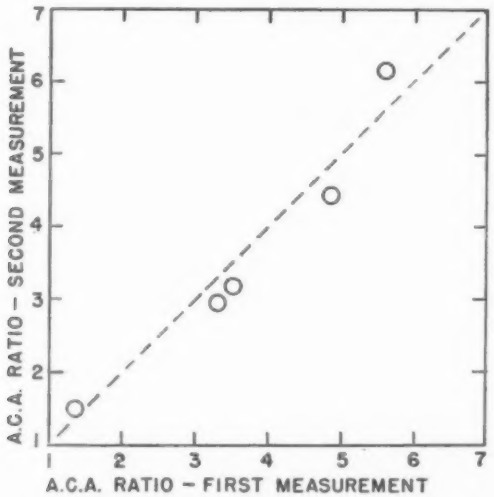


Fig. 6. COMPARISON OF FIRST AND SECOND MEASUREMENTS OF THE A.C.A. RATIO OF FIVE SUBJECTS.

TABLE I
(Asterisks indicate paralytic or post-operative cases)

Subject	Age	Eye Fixating	Duration (Years)	Tropia (Centrads)	A.C.A. Ratio
H.H.	34	O.S.	34	29.0 exo.	2.5
P.M.	19	O.D.	15-19	20.1 eso.	4.0
W.H.	23	O.D.	3-4	24.2 exo.	3.4
M.R.	19	O.S.	0-19	7.3 eso.	10.4
H.S.	22	O.S.	19-22	35.4 eso.	5.6
*M.B.	12	O.D.	9-12	4.6 eso.	7.1
C.R.	19	O.D.	10-19	8.8 eso.	5.0
D.F.	19	O.D.	11-19	30.2 eso.	3.5
*N.M.	15	O.D.	4-15	18.6 eso.	6.3
P.S.	13	O.D.	1-13	7.4 eso.	3.2
J.M.	19	O.S.	14-19	29.9 exo.	2.9
M.G.	20	O.D.	1-20	4.1 exo.	1.1
*B.M.	16	O.D.	11-16	13.6 exo.	2.5
A.T.	16	O.D.	5-16	24.8 exo.	3.5
*G.A.	33	O.D.	3-4	4.6 exo.	1.4
M.M.	13	O.D.	0-13	23.3 exo.	5.8
M.K.	18	O.D.	15-18	20.6 eso.	3.3
S.F.	26	O.S.	20-26	16.8 eso.	4.4
B.G.	26	O.D.	20-26	29.8 exo.	6.7
S.L.	19	O.D.	0-19	22.3 exo.	2.5
*M.Br.	20	O.D.	10-20	15.3 exo.	2.4
B.H.	20	O.D.	17-20	35.6 exo.	6.1
R.H.	19	O.D.	16-19	23.6 eso.	4.9
R.S.	12	O.D.	6-12	8.4 eso.	1.9
*R.F.	18	O.D.	15-18	3.7 exo.	5.1
*V.H.	5½	O.S.	5-5½	7.6 eso.	1.6
L.B.	12	O.D.	0-12	12.9 exo.	3.8
Average for cases without paralysis or muscle operation:	20		10-18	2.9 exo.	4.2±2.0

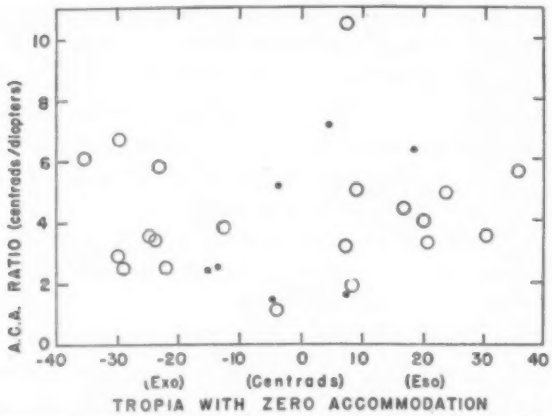


Fig. 8. SCATTERPLOT OF ANGLE OF SQUINT AND ACCOMMODATIVE CONVERGENCE IN 27 SUBJECTS.

The dots represent cases with muscle paralysis and cases with previous muscle operations.

angle of squint is indicated as positive when the eyes converge, and negative when they diverge, from parallelism.

Five of the subjects were given subsequent examinations to ascertain the reliability of the ACA ratio and the distance tropia determinations. The results are given in Table 2. In three of the cases the second examination was made with the opposite eye fixating the stimulus object (reduced Snellen Chart) while the originally fixating eye was observed for determining the angle of squint. In three of the cases the subsequent examinations were made on later days. The degree of correlation of the first and second tropia findings in the five subjects is illustrated in Fig. 5. The degree of correlation of the first and second ACA ratio findings is illustrated in Fig. 6.

In view of the high degree of reliability indicated by the repeated measurements of the ACA ratio and the angles of squint in the five

TABLE II

Results of measurements made on five subjects examined twice.
See Figs. 5 and 6 for graphical presentation.

	First Measurements				Second Measurements			
Subject	Date	Eye Fixating	P.R. Tropia (Centrads)	A.C.A. Ratio	Date	Eye Fixating	P.R. Tropia (Centrads)	A.C.A. Ratio
G.A.	4-19-41	O.D.	—4.6	1.4	4-19-41	O.S.	—12.5	1.5
H.S.	6-18-40	O.S.	35.4	5.6	7- 5-40	O.S.	38.6	6.1
A.T.	4-19-41	O.D.	—24.8	3.5	5-24-41	O.D.	—22.2	3.2
R.H.	12- 8-41	O.D.	23.6	4.9	12- 8-41	O.S.	18.8	4.4
M.K.	11-22-41	O.D.	20.6	3.3	4-25-42	O.S.	25.2	3.0

cases, the data for the whole group may be considered sufficiently reliable to demonstrate the absence or presence of any correlation between the angles of squint and the ACA ratios. The scatter plot shown in Fig. 8 may be taken as evidence that there is no significant degree of correlation between the two functions.

AUTHOR'S DISCUSSION

The demonstration of the presence of a significant amount of accommodative convergence in a subject with a congenital absence of vision in one eye should be ample proof that the accommodative convergence present is an innate and not a learned function. The explanation of its existence would then most logically be referred to neurological connections within the central nervous system, and most reasonably at, or in, the region of the third nerve nucleus, since this nucleus provides innervation to both the accommodation and convergence motor systems.

Likewise, convincing evidence of the innateness of the accommodative convergence function would be provided by the demonstration of its presence in a case of congenital and permanent squint not attributable to the absence of vision in one eye, since even in such a case the normal association of the accommodation and convergence would not occur.

Unfortunately, in the 27 cases of squint reported in this investigation it was not possible to verify the congenital existence of any of the anomalies in question except on the basis of the case history. It is not unreasonable to suspect, however, in any instance, that if a subject can provide no clue as to the possible date of onset, the anomaly has existed since birth. The distressing symptoms attending the onset of a squint occurring later in life support the reasonableness of this suspicion. Also, in several of the cases reported there was further evidence of the congenital existence of the squint in the subject's report that he had one or more close relatives who squint.

In view of these facts, and in view of the fact that the presence of squint at birth is not rare, it is very probable that at least several of the squinters reported in this investigation have never experienced normal binocular vision.

The data, however, show that every one of the subjects demonstrates a positive and significant degree of relationship between accommodation and convergence, this relationship being expressed numerically as the ACA ratio.

Another analytical approach may be made by considering the possible correlation that may exist between the ACA ratio and either the

actual duration of the squint or the relative duration in terms of the subject's age. The existence of any such correlation might be related to either or both of two basic factors, namely, that the squints of greatest actual or relative duration would more likely include the cases that had never had binocular vision, or that the increase in length of time during which normal binocular vision was absent might result in a reduction of the degree of relationship that had developed between accommodation and convergence. Either factor would depend upon the assumption of a learning process.

While the data in Table 1 do not readily lend themselves to a graphical demonstration of the presence or absence of a correlation between the duration and the ACA ratio, a study of the individual cases in the table does not suggest the existence of any such correlation. More specifically, if the average ACA ratio of several of the cases with practically life-long squint is compared to the average for the remainder of the group it will not be found significantly different.

The measurement of accommodative convergence in squinters is of further value in that the data so obtained can be compared to the data obtained in subjects with normal binocular vision. This comparison should demonstrate whether or not the development and existence of accommodative convergence is dependent upon learning processes that may be involved in the simultaneous use of accommodation and convergence that naturally occurs in normal binocular vision.

In fifty college students between the ages of 20 and 30 years with normal binocular vision Morgan[11] found an average ACA ratio of 4.0△ ± 1.5△. In twenty-eight seniors in optometry with normal binocular vision the writer[8] found an average ACA ratio of 4.6△ ± 2.5△ (standard deviation). Both of these investigations were conducted on haploscopes and differed fundamentally from the present investigation only in the criteria used for determining the accommodation and convergence in play.

The convergence criterion employed in the two investigations of normal subjects was the subjective alignment of images seen separately with the dissociated eyes. In view of the fact that the normal subjects would have normal retinal correspondence it is to be assumed that there would have been no significant change in the averages if the convergence measurements had been made objectively as in this investigation.

The accommodation specifications in the two investigations of normal subjects represented measurements of actual accommodation in

play whereas the specifications in this investigation were of the stimulus to accommodation which permitted clear vision. The error introduced by this has been discussed in detail by Morgan.[11] It is also demonstrated for one of the subjects reported in this paper in Fig. 4 and Fig. 7A (subject H.H.) For the present purposes it suffices to say that the effect of this error is to reduce the numerical value of the expression for the ACA ratio, so that the ACA values given in Table I are probably less than they would have been had the actual accommodation been measured.

The average ACA ratio for the twenty squinters who showed no evidence or history of paralysis of any of the extra-ocular muscles or who had not been previously operated upon for the correction of squint is 4.2 ± 2.0△ (standard deviation). Taking all of the previously discussed factors into account, it must, therefore, be concluded that the accommodative convergence is no less in squinters than in cases of normal binocular vision.

It is of interest to note that Haines[12] found in a tabulation of the records of 100 normal patients from his private practice that the average ACA ratio was only 2.2△. Haines computed the ACA ratio from the change in the phoria at 40 cm. when taken through the binocular plus-lens-to-blur finding.

In connection with the comparison of the average ACA value of a group of squinters and that of a group of normal subjects a question may be raised on the possibility that the ACA value may vary with the degree of squint and that the average ACA value for a group of squinters might therefore be increased or decreased depending upon the average degree of squint represented in the group. For normal subjects the variation would not be likely to occur because the average distance phoria for a group of, say, 10 or more normal subjects is almost invariably very close to zero, or ortho.

The data reported here eliminate this possible objection in two ways. In the first place it is seen in Fig. 8, that there is no correlation between the angle of squint and the ACA ratio. In the second place, the average angle of squint for the 20 subjects without paralysis or previous muscle operations is 2.9△ exo., which does not differ significantly from the average phoria for a group of normal subjects. It also happens that half of these subjects are exotropic and half are esotropic, so that the data need not be considered as unduly weighted in either direction.

The absence of correlation between the ACA ratio and the angle of squint represents in itself some evidence of the innateness of the accom-

modative convergence, for if the relationship were learned during some period in life when normal binocular vision may have been present it would be expected that the exotrope would develop a larger ACA ratio than the esotrope, not only because of the benefits which would have been gained but also because of the greater amount of voluntary convergence that would have been exercised during development.

The absence of correlation goes a step further in that it points to the nucleus of the third nerve as the locus of the connection between accommodation and convergence as it is doubtful that the brain pathways for accommodation and convergence are in such close connection at any other point. In other words this absence of correlation may be taken to mean that the variation of the ACA ratio from individual to individual can be only secondarily related to the ratio of efficiency of the convergence and accommodation mechanisms, which in turn would mean that the primary factor in its variation is the degree of connection at the point of adjacency in the nerve pathways. The necessity of considering the ratio of efficiency of the accommodation and convergence mechanisms as a possible factor is made obvious by the findings of Flieringa and Van der Hoeve[13] which show that the ratio varies with the degree of induced paralysis of the ciliary muscles.

In making the comparison between the accommodative convergence in squinters and in non-squinters one additional point of similarity may be mentioned, namely, that in both groups the relationship is linear and direct, that the relationship is well represented by a straight line on an accommodation-convergence graph, when the accommodation is designated in diopters and the convergence is designated in degrees or centrads. While this point may have little bearing as evidence for or against the innateness of the relationship it does serve to illustrate the identity of the relationship as measured in squinters and non squinters.

SUMMARY AND CONCLUSIONS

The measurement of the convergence produced by accommodation in 27 cases of squint showed in every case a direct and linear relationship between the accommodative convergence expressed in centrads and the accommodation expressed in diopters. The average ratio of the accommodative convergence to accommodation, referred to in this paper as the ACA ratio, was $4.2 \pm 2.0\triangle$ (standard deviation) for the 20 cases in which there was no evidence of muscle paralysis or no history of muscle operations. The twenty cases included ten esotropes and ten exotropes and gave an average angle of squint of $2.9\triangle$ exotropia.

A comparison of the accommodative convergence demonstrated in this group of squinters with the accommodative convergence previously described for non-squinters indicates that the development of accommodative convergence is not dependent upon learning factors in the associated use of accommodation and convergence.[1]

[1]Appreciation is expressed for the assistance received through the White Haines Research Fellowship in 1940, '41, and '42 during which time the data used in this report were obtained.

REFERENCES

1. Hofstetter, H. W., The Zone of Clear Single Binocular Vision, American Journal of Optometry and Archives of American Academy of Optometry, Vol. 22, No. 7, July, 1945, pp. 301-333.
2. Maddox, E. E., The Clinical Use of Prisms, Fifth Edition, London, 1907, pp. 158-177.
3. Hofstetter, H. W., The Proximal Factor in Convergence and Accommodation, American Journal of Optometry and Archives of American Academy of Optometry, Vol. 19, No. 2, February, 1942, pp. 67-76.
4. Hofstetter, H. W., A Postural Component in Convergence (not published). Original draft submitted in 1941 as part of a general report of research activities under the White-Haines Research Fellowship.
5. Donders, F. C., Accommodation and Refraction of the Eye (English Translation). London, 1864, pp. 291-308, 402-403.
6. Ibid, pp. 110-126.
7. Landolt, E., Refraction and Accommodation of the Eye (English Translation). Edinsburg, 1886, pp. 196-208.
8. Starling, E. H., Human Physiology, Section on Vision by H. Hartridge, Third Edition, Philadelphia, 1920, pp. 495-497.
9. The Synoptiscope, 1938, Keystone View Company, Meadville, Pennsylvania.
10. Yule, G. V., and Kendall, M. G., Theory of Statistics, Twelfth Edition, J. B. Lippincott Co., 1940, pp. 206-211.
11. Morgan, M. W., Jr., Accommodation and Its Relation to Convergence, American Journal of Optometry and Archives of American Academy of Optometry, vol. 21, No. 5, May, 1944, pp. 183-195.
12. Haines, H. F., An Experimental Analysis of the Factors Affecting the Relationship Between Accommodation and Convergence, Thesis for the Master of Science Degree, The Ohio State University, Columbus, 1938.
13. Flieringa, H. J., and van der Hoeve, J., Arbeiten aus den Gebiete der Akkommodation, Albrecht von Graefe's Archiv für Ophthalmologie, vol. 114, 1924, pp. 1-46.

DISCUSSION

Marguerite Thoma Eberl†
Milwaukee, Wisconsin

My interest in Dr. Hofstetter's paper can be stated simply: Has he proven that the change in convergence induced by a change in accommodation is congenital-innate and fixed by inheritance, and if he has so proven, what significance has that in our conception of seeing as a learned skill susceptible to modification through training.

†Optometrist. Fellow of American Academy of Optometry.

In my opinion the argument that squinters and those who have never known binocular fusion are suitable subjects upon which the crucial experiment can be made is in error. To show that any function is truly innate, it should be examined before any possibility of transformation through use, practice, learning or training could possibly have taken place. This would need to be then at birth. Such studies have been made and I shall give their results later.

However, let us set aside this objection for the moment, and accept his statement that the influence of learning is eliminated as a factor by measuring the accommodative-convergence relation as it exists in a pair of eyes that have never attained binocular vision. I hold that his selection of subjects upon whom the experiment is based is open to serious question, since in too many of his subjects there is no proof that they have never had binocular vision or have had no opportunity to learn an accommodative-convergence relationship. I object to his assumption that "It is not unreasonable to suspect that if a subject can provide no clue as to the possible date of onset the anomaly has existed since birth." In my own practice my squint patients rarely if ever recall the onset of the squint. Parents and relatives notice it first and then rarely report that it was present at birth. I disagree also with his statement that "the distressing symptoms attending the onset of a squint occurring later in life support this suspicion," since it does not square with my clinical experience. I assume the statement to imply that since the symptoms were distressing, the child would remember it. I cannot in my own practice find a single squint case which occurred within the time that a child might reasonably be supposed to remember in which the child complained of distressing symptoms. I do not think we can accept this as proof that learning has not been present. Ling (who did the experiments on new born children and from whom I shall quote later) concludes in speaking of vision, "Learning through use starts as soon as the child is born." Giving Dr. Hofstetter the benefit of the doubt in those cases where there is any even doubtful evidence that the squint existed from birth, 19 of his 27 cases show no evidence that the squint existed from birth. Therefore, at least these cases in my opinion must be considered invalid and on that basis his experiment would be open to question.

That objection, however valid, I merely regard as technical because if he had had 27 cases which beyond a doubt had never had binocular vision his experiment would have turned out the same and would have proven a point already known. Carr (University of Chicago) in his

investigation on "Space Perception" has already proven exactly what Dr. Hofstetter attempted to prove, that is, that accommodation and convergence are both used in monocular vision. In monoculars there is always parallactic vision and any change of target from far to near must induce a movement of the globe nasalward. Dr. Hofstetter's conclusion, however, that when in the monocular a change in accommodation causes a change in convergence, it must be due to innateness is completely contradicted by Carr. He states that "accommodation and convergence are present in both binocular and monocular vision," (page 226) that being the case, the changes would be expected to be practically the same in monoculars and binoculars, for judgments must be made in space and (as Carr notes) the "persons who have lost one eye are in no serious disadvantage in this respect." (Page 221). His conclusion in the matter is, "We are still confronted with the question of whether the utilization of this factor is innate or empirical in origin. There are no facts upon which to base a definite decision." (Page 252).

As noted, Carr mentions the judgments in space of the monoculars. Visual space is a more complex matter and certainly involves the unity of the senses (Von Hornbostel) so that the monocular builds his space world by a process of field structuring in which the muscles, the skin, the ears, the tendons, the joint surfaces, etc., all play an important role. Von Frey pointed out that vision alone *cannot* give position, size or distance. This must be then a matter of learning.

To diverge for a moment before proceeding with this problem of learning, I want to consider his statement that a nucleus of the III pair of cranial nerves controls these functions (accommodation and convergence.) If this be true, why are half of his cases exotropes and half esotropes. Were they always this way? Such a view of canalization in the central nervous system would be held by few if any neurologists, geneticists or psychologists. Against it is the overwhelming weight of Paul Weiss: "Principles of Development." C. M. Child, "Physiological Foundation of Behavior," also "Problems of Behavior."

Now to turn to those studies which seem to argue for the learned relationship. Among the several deficiencies of Dr. Hofstetter's argument for the innate character of the accommodative-convergence relationship, the work of Miss Ling at Yale is the most interesting and important. Her study is entitled "A Genetic Study of Sustained Visual Fixation and Associated Behavior in the Human Infant from Birth to 6 Months." Ling found "Opposed to the strictly nativistic hypothesis are the absence

of convergence until about the end of the second month." "Learning through use starts as soon as the child is born." Anyone who has seen the motion pictures made by Miss Ling cannot fail to be impressed by the fact that accommodation develops earlier and that monocular fixations are achieved earlier than binocular ones. Now you might argue that binocular convergence is an innate but delayed appearing function in distinction to a developing function and that therefore her results do not disagree with those of Dr. Hofstetter. Such an argument is, I believe, unsupported by facts. The motion pictures show that the achievement of convergent fixations are clearly and unmistakably a matter of what Dodge calls approximation and correction. If this does not constitute a clear cut instance of learning in infancy, then we may as well go the whole route and say that every complex movement of which adult beings are capable is innate and fixed in inheritance. Such an extreme position is not only indefensible, it is absurd. I might add that the movements of convergent fixation described by Listing and Donders are among the most complex muscular synergies found in the body and that there is no evidence that any complex movement can ever be regarded as innate.

And last, one is tempted to say, "All right, suppose the A-C-R is innate"—"So what?" We know that there is phylogenetically developed pattern for walking, yet the baby himself must add experience to it. That is the sense in which we use the word "learning." In fact, we agree that there exists a phylogenetically developed relation in all associated actions—the two legs, the two arms, etc., the learned relationships we discuss are learned relationships between behavior patterns.

Dr. Hofstetter's paper proves what has long been known: Accommodation and convergence change covariantly. It does not tell the origin of this relation or its place in a systematic theory of vision, nor does it square with my understanding of modern biological and psychological theory and fact.

Since I am not a scientist in the accepted sense of the word, but only a practical optometrist, unskilled in the patois of the research laboratory, I turned to others who are in a better position to evaluate the study. I should like to quote from comments by Arnold Gesell, Yale University School of Medicine, on the subject:

"I would take initial exception to the isolableness of the three so-called components of the normal act of convergence. They may, of course, be separated for purposes of discussion; but I question whether they can be separated in experimentation or in final interpretation. Tonic

convergence, certainly, is not a fixed invariable. The term "basic tonus of the extra-ocular muscles" masks the fact that all tonus is sensitive to the total context of conditions, including reciprocal innervation and subtle body states and postural sets.

"Assume that a direct, linear relationship between accommodative convergence and accommodation has been established by the study. This is a somewhat static finding, if taken at face value without reference to possible developmental factors. In any event it can scarcely mean that the functional relationship is immune from embryogenic and experiential influences.

"This leads us to the basic theoretical consideration alluded to. It is extremely artificial to make a sharp cleavage between maturation and learning. The two processes operate conjointly in nature. Maturation represents the net sum of the gene effects. It is intrinsic. It provides the condition and the matrix for acquired or "learned" behavior. I put quotes around learning, because as you know, a child really does not learn to walk. He walks when he is maturationally ripe and ready; but the occasions, and in subtle ways the style of his ambulation may be configured by secondary factors (operating in conjunction with the intrinsic).

"The concept of maturation emphasizes the (molar) unity of the organism and the priority of the total pattern of response. This unity of the organism is not conceived in mystical terms, but is identified with the functional and structural unity of the total reaction pattern.

"Now there is always a margin of ontogenetic plasticity in this total pattern and in the areas thereof. Development does not consist in a compounding of unitary reflexes. The total pattern has primacy; it has a basic developmental physiology which normally makes it immune to excessive conditioning. Secondary, experiential or environmental influence inflect and impose specific configurations; but they do not engender the basic sequences of development.

"I take it that all theoretical discussion of the accommodation-convergence patterns must take into account the synthetic relationship of maturational and more secondary factors. The burden of proof is on those who hold to unadulterated innate fixity."

For some reason there seems to be a disinclination to admit a general fact: Almost all functions of living things can be changed, transformed or modified by use, training and learning. Vision is not an exception. Here lies one of the basic and challenging tasks for modern optometry.

THE AFTER EFFECT OF LATERAL DUCTION TESTING ON SUBSEQUENT PHORIA MEASUREMENTS*

Mathew Alpern†
U. S. Army. Hospital Center. Camp Carson, Colo.

The phoria position has been defined as the position the eyes assume when they are in a fusion free state, i.e., (as Peter[1] states) the position of functional rest. Morgan[2] has shown that the phoria test is a measure of the influence of many factors on the direction of the visual axis. Chief among these factors is the tonicity of the twelve extra ocular muscles. Adler[3] has shown that this tonicity in turn is influenced by several factors. It is certainly conceivable that the stimulation of the neuromusculature of the extra ocular muscles such as occurs in lateral duction testing, has a direct influence on this muscle tone. If this is true, then duction testing should cause a change in the tonic convergence which would manifest itself by erroneous findings in subsquent phoria measurements. In this regard Morgan[4] states, ". . . When either the adduction or abduction, or both, is measured just prior to making the fusional supplementary convergence (i.e., phoria at near) test, the tonicity of the extra ocular muscles is sometimes disturbed and the nerve impulse induced by the duction tests tend to carry over so that an erroneous result is obtained in the fusional supplementary convergence test." To date, however, no work has been published which attempts to demonstrate this effect or to determine its quantitative significance.

It was the purpose of this experiment to study the effect of lateral duction testing on subsequent phoria measurements and to determine if the phenomenon of after discharge was sufficiently great to warrant an alteration of the standard clinical testing procedure.

Unfortunately, research studies of the effects of visual tests on subsequent measurements in the visual analysis are relatively few. Bielschowsky[5], among others, has reported that maintaining the eyes in a vertical divergent position long enough for duction testing, affects the eyes in such a manner that they do not immediately return to the normal phoria position upon disassociation. This fact has been verified by Ellerbrock and Fry[6] who demonstrated that in the measurement of the vertical duc-

---

*Read before the Twenty-second Annual Meeting of the American Academy of Optometry, on December 12, 1945, at Columbus, Ohio. For publication in the October, 1946, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF THE AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Fellow of American Academy of Optometry.

tions if the base-up test was made immediately prior to the base-down test in the same eye, the latter finding would be altered. The experiments of Jaques and Crow[7] indicate that prolonged wearing of either minus or plus lenses over and above the static refraction affect the phoria findings in a definite manner.

The subjects used in this study were patients and members of the staff of the Eye, Ear, Nose and Throat Service of the United States Army General Hospital, Camp Carson, Colorado. All cases had a visual acuity of 20/20 in each eye, or were correctible to 20/20 with lenses. Each subject had normal single binocular vision, and an amplitude of accommodation of at least five diopters. Although it was possible to eliminate cases with ocular pathology from the study, several of the subjects that had some form of general pathology, were included in the study due to the limited number of available subjects. There were four cases with some form of general pathology, three of whom were liberated prisoners of war of the Japanese and were hospitalized for malnutrition, one being hospitalized for acne. The findings in these cases did not differ materially from the findings in the other subjects so the results were included in the data. No subjects hospitalized for neuro-psychiatric reasons were included.

Tests were made on the standard American Optical Company phorometer, number 560-N, with rotary prisms and Maddox rod attached. The target for distant testing was the 20/20 letters of the American Optical Company projecto chart. The target for near testing was the light of a retinoscope bulb placed at sixteen inches from the spectacle plane of the phorometer. The centers of the pupils were accurately aligned with the center of the lenses when the phorometer was level. If the subject wore a correction, its equivalent was inserted into the phorometer.

The phoria for distance was first measured using a rectangle of light containing a 20/20 letter as a test target, in a dark room. The Maddox rod was placed before the left eye and the rotary prism before the right eye. The subject was instructed to keep the letter clear while the rectangle and vertical streak were aligned by adjustment of the rotary prism. This procedure was a modification of the method used by Morgan[8] in which a cover technique was used to keep the accommodation static. Due to the limited time allotted for each test, the cover test was not practical and the accommodation was controlled by making the subject keep the test letter clear.

The phoria for near was taken next using a Maddox rod, rotary prisms, and a light as the test object. This was followed by the lateral duction tests for distance. The test object was a vertical line of 20/20

letters. Ductions were measured by turning an equal amount of prism over each eye simultaneously, base out to blur, break and recovery first, followed by base in to break and recovery. The phoria tests at distance and near were then repeated.

The results obtained in the forty-nine cases studied are shown in Figure 1 and Figure 2. Figure 1 represents a scatter diagram showing the

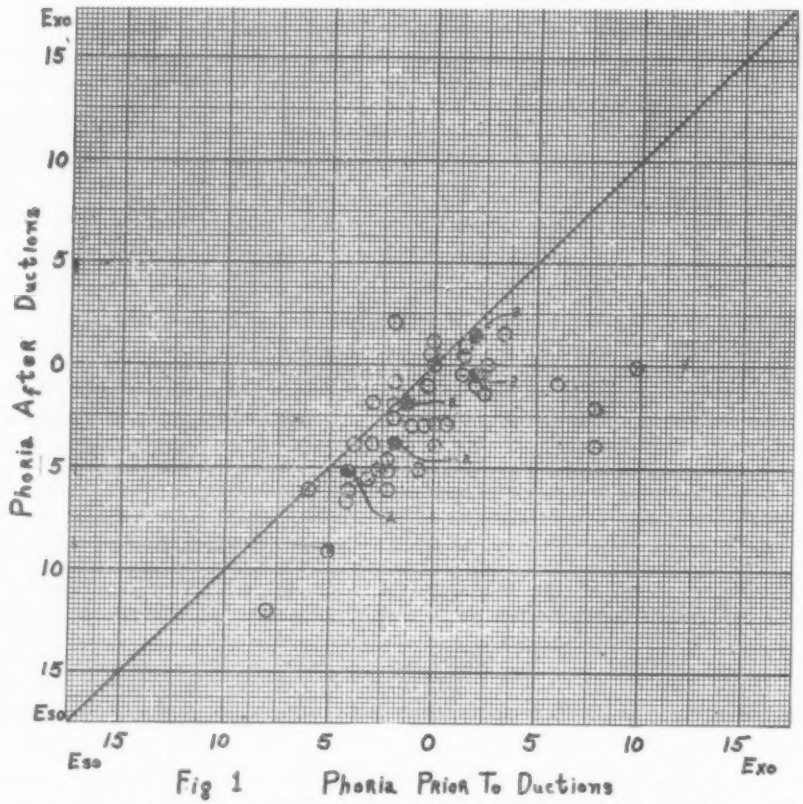


Fig 1

after effect of the lateral ductions on the phoria at distance. If the effect had been nil then all the points plotted would fall on the diagonal of the graph. The fact that only four points fall on the diagonal of the graph is therefore significant. It is seen that only nine points fall on or above the diagonal, while forty points fall below the diagonal. This means that in forty cases the ductions tend to affect the tone of the muscles in such a manner as to cause an erroneous reading in the subsequent phoria measurement in the direction of esophoria.

Figure 2 shows the after effect of the lateral ductions on the phoria

at near. The same effect noted in the distant measurement is apparent here, although not to the same extent. This graph shows two points on the diagonal, fifteen points above the diagonal, and thirty-two points

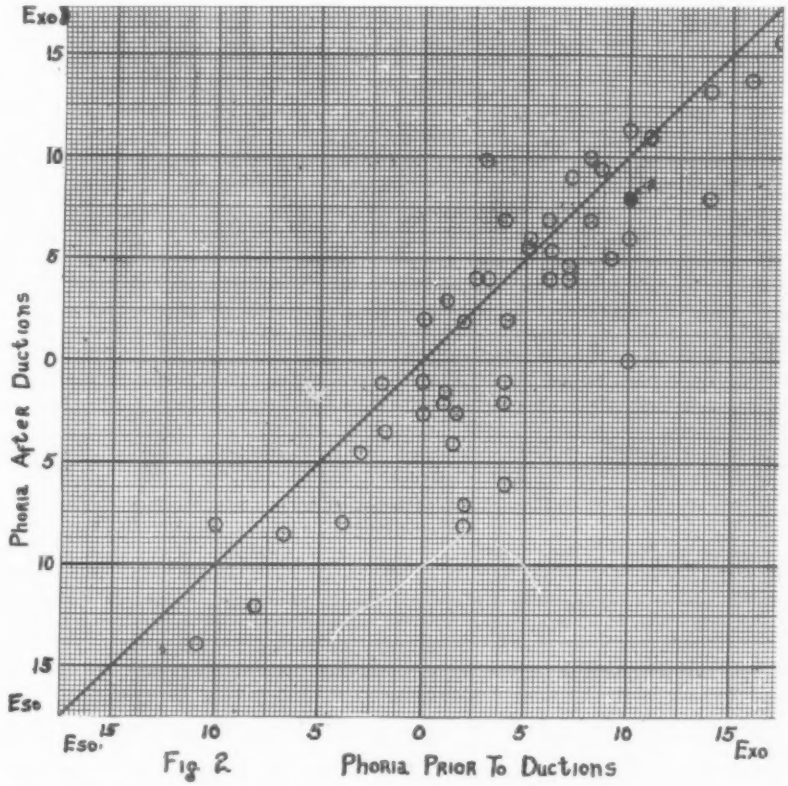


Fig. 2

below the diagonal. Here again, the ductions at distance tend to alter the phoria in the direction of more esophoria, in the majority of cases.

It cannot be determined from the experiment precisely why the ductions should tend to induce more esophoria in the subsequent phoria measurements. However, one explanation may be that since the adduction invariably involves a greater amount of neuro-muscular effort in testing than the abduction test, that the tone of the muscles actively involved in convergence is affected more than the tone of the muscles actively involved in divergence.

It is difficult to determine from the experiment exactly why the effect should be more significant on the distant phoria than on the near phoria. Most probably this is due to the fact that the phenomenon of

after discharge affects the tone of the muscles for a limited time only. Thus, since the phoria at distance was taken immediately following the duction, the effect should be more pronounced than in the near phoria which followed the distance phoria. Precisely how much time is required for the effect to completely disappear cannot be determined from these results, and should be the subject for further research. Apparently, however, this will vary in individual cases.

SUMMARY AND CONCLUSIONS

The after effect of lateral duction testing on subsequent phoria measurements was studied in forty-nine prepresbyopic subjects. The results clearly indicate that the process of measuring lateral ductions has a definite effect on subsequent lateral phoria tests. In the majority of cases this tends to cause a greater amount of esophoria to be measured than is actually present. The length of time required for this effect to disappear was not determined in this study and should be the subject of future experimentation. Until the time when such data are available, however, it becomes necessary for those who are interested in accurate findings in visual analysis to alter their clinical routine. At present, the standard clinical routine is to take all distance measurements prior to any near tests.[9] This, of course, means that four phorias at near are taken a very short time after the distance duction tests. It is obvious from the data of this experiment that such a procedure is likely to yield erroneous findings in the near phoria measurements. Therefore, duction tests should be taken only after all phoria measurements at distance or near have been made.

The results of this experiment indicate that more intensive research is necessary to determine (a) the time necessary for the after effect of the duction tests to completely disappear. (b) The results obtained if the near phoria findings were taken immediately following the duction tests, and (c) the results obtained if the routine of duction testing were reversed, i.e., the base-out duction taken after the base-in.

208 HILL BLDG.
1004 E. MARKET ST.
AKRON, OHIO

BIBLIOGRAPHY

1. Peter, Luther C., *The Extra-ocular Muscles*, Lea & Febiger, Philadelphia, 1941, p. 89.

2. Morgan, Meredith W., Jr., *Analysis of Clinical Data*, American Journal of Optometry and Archives of the American Academy of Optometry, December, 1944, p. 481.

3. Adler, Francis H., *Pathologic Physiology of Convergent Strabismus*, Archives of Ophthalmology, May, 1944, pp. 374-375.

4. Morgan, Meredith W., Jr., *The Clinical Aspects of Accommodation and Convergence*, American Journal of Optometry and Archives of the American Academy of Optometry, August, 1944, pp. 303-304.

5. Bielschowsky, A., *Lectures on Motor Anomalies*, Dartmouth College Publications, 1939, p. 12.

6. Ellerbrock, V., and Fry, G. A., *The After-Effect Induced by Vertical Divergence*, American Journal of Optometry and Archives of the American Academy of Optometry, Oct., 1941, pp. 450-454.

7. Jaques, Louis, and Crow, George, *Applied Refraction*, Harry R. Day, Los Angeles, California, 1934, pp. 58-60.

8. Morgan, Meredith W., Jr., *The Clinical Aspects of Accommodation and Convergence*, American Journal of Optometry and Archives of the American Academy of Optometry, August, 1944, p. 302.

9. Michels, Roy A., *Fundamentals of Modern Optometric Practice*, Doctoral Dissertation, Los Angeles School of Optometry, p. 15.

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Established 1924

Vol. 23 OCTOBER, 1946 No. 10

EDITORS AND STAFF

Dr. Carel C. Koch ..... *Editor*
Dr. J. Fred Andreae ..... *Associate Editor*
Dr. Arthur P. Wheelock ..... *Associate Editor*
A. Virginia Huck ..... *Editorial Assistant*
Harry Brookins ..... *Advertising and Production Manager*
L. L. Koch ..... *Circulation Manager*

Publication and Academy Office: 1502 Foshay Tower, 821 Marquette Ave.
Minneapolis 2, Minnesota

Annual Subscription, $5.00 in Advance; Canada, $5.50; Foreign, $6.00;
Single Copies, 50c.

Original papers, scientific communications, clinical reports, books for review, and correspondence should be sent to the editor. Subscriptions and applications for single copies should be addressed to the circulation manager. Copy of advertisements must be sent in by the first of the month preceding their appearance. Communications with reference to advertising or other journal business should be addressed to the advertising manager. Academy correspondence should be addressed to Dr. Carel C. Koch, Secretary of the American Academy of Optometry.

Published Monthly by the
AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION

The American Academy of Optometry and the publishers of this journal have no objection to the reprinting by other magazines of any of the articles in this issue, provided such reprints are properly credited to the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

VISUAL PROBLEMS OF SENIOR HIGH SCHOOL STUDENTS

The Hindu philosopher, Tagore, says, "In the world of human affairs there is no worse nuisance than a boy at the age of fourteen. He is neither ornamental nor useful. It is impossible to shower affection on him as on a little boy; and he is always getting in the way . . . He grows out of his clothes with indecent haste; his voice grows hoarse and breaks and quavers; his face grows suddenly angular and unsightly . . . When he talks with elderly people he is either unduly forward or else so unduly shy that he appears ashamed of his existence."

The above statement is rather severe criticism and pessimistic but

with those of us who deal with the adolescent youth there is much meaning and warning in our criticisms of the high school boy and girl.

The normal pupil upon entering senior high school is usually just getting over his most rapid growth period. Some are near the peak of rapid physical development. If the youngster begins the first grade at the age of six, regular promotion will place him in the first half of the tenth grade (first semester of senior high school) at the age of fifteen.

In a child of eight the muscles constitute about 27% of his weight; at fifteen they constitute nearly 32%; and at sixteen they have jumped to 44%. It is interesting to note that sometimes bones and muscles appear to vie with each other in rapidity of growth; when the muscles forge ahead, there is a looseness of muscles and the consequent clumsiness and lack of coordination; if the bones excel, he has cramps and "growing pains."

The writer has been checking the eye-sight of senior high school pupils for many years and in so doing, certain facts are outstanding.

(1) In the recent survey of 640 B10 pupils, 28% showed a difference between the two eyes of 1 △. (1 △ means one step on the Snellen Chart such as 20/20 and 20/30 or 20/15 and 20/20, etc.)

(2) In the same survey, 8% showed a difference between the two eyes of 2 △ or more.

(3) Many cases of poor fusion.

(4) Many cases of correctable astigmatism.

(5) Many cases where corrections had been worn but because of broken lens, glasses having been lost, refusal to wear glasses because of pride or fear of ridicule, their eyes were receiving no help now.

In "Reading as a Visual Task" by Luckiesh and Moss, we find these statements which may throw some light on the ocular problems of youth:

> "It appears that the brain likewise demands and receives clear and effective vision even though the ocular mechanisms may have been considerably fatigued by prolonged critical visual effort . . . The fact that a given visual task is performed with undiminished speed and unimpaired precision is not to be considered as evidence that the task is performed with ease, due to possible voluntary and involuntary compensation of the effects of fatigue."

We must also remember that the senior high school boys and girls are at or near the greatest powers of accommodation and convergence and

therefore they do not realize the tremendous task they are demanding of these faculties.

May not the above facts partially explain a cause for the statement made by the American Optometric Association in its "Optometry and Vision, Facts and Figures";—"A recent government survey indicates that myopia increases about 600% between the first and fifth grades"?

If this statement is true it is extremely significant. Very questionable, in this writer's opinion, is a statement, reported in one of the large Los Angeles daily papers, as made by one of our National lecturers, implying that "45% of teen-agers entering high school cannot read above the fourth grade" because of optical defects.

The writer has made several surveys of the eye-sight of poor readers in high school with the definite results that the correlation between eye-status and reading ability on the high school level is so low that it has no significance. One such study gave the correlation as 0.08. The critical Ratio formula applied to this result shows it to be not significant.

In conclusion, it seems to the writer that two solutions to the ocular problems on the high school level are:

(1) Eye-sight surveys to be made of all pupils early in the elementary grades, as well as each year: if possible, through the public school years.

(2) Eye-sight education for both parents and pupils, in the press, radio and moving pictures.

The writer also wishes to recommend that the optometric press publicize the results of more careful scientific studies with data submitted to statistical analysis.

J. G. GOODSELL.[1]

---

[1]J. G. Goodsell, M.A., Opt. D., is principal of Polytechnic High School, one of the largest and most efficient schools in the Los Angeles area. He is well known in educational circles for his interest in the Visual Aspects of Education. He is a graduate of the University of Southern California and the Los Angeles School of Optometry, and in addition to his optometry license, since 1924 has held a California State Board of Education Credential in Health and Development work as Optometrist Inspector. In these activities he has had the close cooperation of the Medical Department of the city school system. For several years he has been a member of the Board of Directors of the Los Angeles School of Optometry, recently succeeding Dr. Arthur Hoare as President of the Board.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

PROGRAM OF ANNUAL MEETING OF ACADEMY AT PHILADELPHIA

BELLEVUE-STRATFORD HOTEL*

SUNDAY, DECEMBER 8, 1946

9:00 A.M.
Registration.

10:00 A.M.
Business Session.
J. Fred Andreae, O.D., President's Annual Report.
Carel C. Koch, O.D., Secretary's Annual Report.
Reports of Local Chapters.
Committee Reports.
"Definition and Measurement of Torsion," Committee on Nomenclature and Standards.
Glen A. Fry, Ph.D., Chairman.

1:30 P.M.
"Search and Research."
Lewis H. Kraskin, O.D.
Washington, D. C.

2:00 P.M.
Discussion.

2:15 P.M.
"Organization of the Specialties in Optometry."
Galen F. Kintner, O.D.
Wabash, Indiana.

2:35 P.M.
Discussion.

*Hotel reservations should now be made.

2:45 P.M

"The Basis of Failure on Color Blindness Tests."
Charles S. Bridgman, Ph.D.
School of Optometry.
Ohio State University.

3:05 P.M.

Discussion.

3:20 P.M.

"An Analysis of a Number of Cases Seen in an Industrial Eye Clinic."
Ernest Petry, O.D.
Rochester, New York.

3:50 P.M.

Discussion.

4:05 P.M.

"Near Point Problems in Modern Industries."
Richard Feinberg, O.D.
Purdue University.
LaFayette, Indiana.

4:35 P.M.

Discussion.

7:00 P.M.

Contact Lens Section.
Eugene Freeman, Ph.D., Chairman.

MONDAY, DECEMBER 9, 1946

9:00 A.M.

Orthoptics Section.
E. J. Margaretten, O.D., Chairman.
"Lecture and Demonstration on the Latest Developments in the Correction of Squint."
E. J. Margaretten, O.D.
New York, N. Y.
M. N. Chodroff, O.D.
Brooklyn, N. Y.

12:00 A.M.

Recess.

1:30 P.M.

"Certain Variations in the Angle of Deviation in Concomitant Squint."
H. W. Hofstetter, Ph.D.
School of Optometry.
Ohio State University.

1:50 P.M.

Discussion.

2:00 P.M.

"The Effect of Prism on Esotropia, a Case Report."
Mathew Alpern, O.D.
H. W. Hofstetter, Ph.D.
School of Optometry.
Ohio State University.
Columbus, Ohio.

2:20 P.M.

Discussion.

2:30 P.M.

"A Clinical Evaluation of the Use of Slab-off Prisms."
V. J. Ellerbrock, M.Sc.
Research Fellow, Physiological Optics.
Ohio State University.

2:50 P.M.

Discussion.

3:00 P.M.

"The Theory and Application of Tri-focal Lenses."
Roy Marks, O.D.
Dayton, Ohio.

3:20 P.M.

Discussion.

3:30 P.M.

"Significance of Visual Acuity Measurements Without Glasses."
Glenn A. Fry, Ph.D.
School of Optometry.
Ohio State University.

3:50 P.M.

Discussion.

4:00 P.M.

"Analysis of Successful and Failure Aniseikonic Cases."
(A Study of the Data in 200 Cases.)
Robert E. Bannon, O.D.
Rudolph T. Textor, O.D.
Dartmouth Eye Institute.

4:45 P.M.

Discussion.

7:00 P.M.

Formal Banquet.

TUESDAY, DECEMBER 10, 1946

All-day session at Pennsylvania State College of Optometry.

Chartered buses will leave the hotel at 9:30 A.M. for the College. Lunch will be served at the College.

The program will consist of a paper on "Ocular Neurology" in three parts.

1. "Ocular Neurology Illustrated with Cranial Specimens."
   Onfrey G. Rybachok, M.A.
2. "Ocular Neurology in Disturbances in the Form and Color Fields."
   Harold Simmerman, O.D.
3. "Ocular Neurology in Disturbances of Single Binocular Vision."

7:00 P.M

Anisiekonic Section.
Harold Fisher, O.D., Chairman.

WEDNESDAY, DECEMBER 11, 1946

9:00 A.M.

"The Basis of Visual Fatigue."
S. H. Bartley, Ph.D.
Dartmouth Eye Institute.

9:45 A.M.

Discussion.

10:00 A.M.

"The Use of Cycloplegia in Refraction."
(A Preliminary Report.)
Robert E. Bannon, O.D.
Dartmouth Eye Institute.

12:00 A.M.

Recess.

1:30 P.M.

"Selection and Training of Optometrists for Special Military Duties."
Henry A. Imus, Ph.D.

1:50 P.M.

Discussion.

2:00 P.M.

Final Business Session.

IOWA CHAPTER—AMERICAN ACADEMY OF OPTOMETRY

Event: Fall Meeting of Iowa Chapter—American Academy of Optometry.

Time: November 4 and 5, 1946.

Place: Cedar Rapids, Iowa, at The Roosevelt Hotel.

Start: Monday, November 4th, 9:30 A.M., Roosevelt Hotel.

The Executive Council is highly pleased to be able to present a series of lectures by men of unquestionable authority. Iowa Chapter members are fortunate in being able to attend a meeting that will offer information so vital to the proper practice of Optometry.

Monday: James H. Grout, O.D., D.O.S., Professor of Optometry and Director of Clinics at Northern Illinois College. Dr. Grout's subjects will include the latest refractive technique as developed at Northern Illinois College, along with a complete explanation of the theory and practical use of the crossed cylinders in refraction. The application of the spherical equivalent in correcting astigmia will also be completely covered.

Monday Evening: Chapter Banquet—Roosevelt Hotel—8:00 P.M.—Informal.

Tuesday: Fay M. Whitsell, M.D., Fellow of American Academy of Ophthalmology and Director of the Department of Ocular Anatomy and Pathology at Northern Illinois College. Dr. Whitsell was a Major in the recent war, and served in the Army Medical Corps and is now practicing ophthalmology in Chicago, in addition to his activities at Northern Illinois College. Dr. Whitsell's subjects will be Glaucoma, its diagnostic symptoms, its causes and the methods of combating this devestating ocular condition. He will also project a series of photographs of fundus pathology as found in various eye conditions and explain each one in detail. His last lecture will be given in conjunction with the projection of colored films illustrating eye surgery performed by himself on such cases as glaucoma, detached retina, squinting eyes, etc.

The Roosevelt Hotel has agreed to hold open a block of rooms for this meeting, with reservations beginning Sunday night, November 3, 1946. If you can arrange your travel so as to get in Cedar Rapids on Sunday, you will be able to attend the opening sessions Monday morning. Do not fail to write the hotel for your reservations immediately so that you will be assured of a room. The hotel will hold the rooms until October 12th, waiting for your reservations. Any reservation requested after that date cannot be guaranteed.

SPECIAL REPORTS

THE PRESENT SITUATION AND THE PROSPECTS FOR THE IMMEDIATE FUTURE OF THE LOS ANGELES SCHOOL OF OPTOMETRY WITH SOME PERSONAL COMMENT ON OPTOMETRIC EDUCATION IN ITS LARGER ASPECTS*

Ernest Hutchinson†
Los Angeles, California

The termination of the war and the liberal provisions of the G. I.

---

*An abridgment of the material presented before the California Optometric Association. Submitted on September 19, 1946, for publication in the October 1946 issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Dean, Los Angeles School of Optometry. Fellow, American Academy of Optometry.

bills 16 and 346 for the education of veterans has brought about a complete transformation of the outlook in the field of Optometric Education. During the war the schools were operating at a loss with greatly reduced student bodies and for a time there were fears that some might not survive.

The Professional Advancement Program designed to bring in more students was to a large extent nullified by the non-exemption of Optometry students from the incidence of Selective Service. Students already in school were not permitted to complete their courses and the situation was very unsatisfactory.

The bills referred to have changed all that and one of the most important decisions facing the schools today is that of determining the needs of the profession in terms of man power. In considering this problem, we need to be utterly realistic. No overly enthusiastic post prandial oratory must sway our better judgment in the direction of building castles in the air to be occupied by flesh and blood optometrists who must have flesh and blood patients to serve in order that they may survive. Without a doubt the territory we serve is headed for another period of rapid expansion but by no stretch of the imagination can we envisage a need for optometrists in the numbers now showing an interest in the profession.

In the period since January first we have responded to over two thousand inquiries and have on file at this writing 188 actual applications for the class of September, 1947. The September, 1946, entering class consists of 90 students which is larger than we originally contemplated mainly on account of former students who presented themselves after the nominal closing of the roster, but who could not equitably be denied re-admission, the present senior class consisting of 75 students.

As to the needs of the territory, we are anxious for all the information available and recommend this matter to your most earnest study. What is needed is specific data and not rough generalizations.

We have increased by 50 per cent the size of our senior class room, adding to our facilities a large, completely furnished orthoptic room and a new, well equipped refracting room. To care for the new junior class we have leased the Trojan theater adjoining our parking lot. Our refracting and orthoptic clinic is adequately staffed and well organized.

We can only wish that orthoptic procedures were as well grounded in solid scientific fact as are the laws of refraction. We deplore the loose use of terminology which can only serve to bring optometry into disrepute.

We make common cause with Dean Minor in our insistence that the schools have no right to teach unproved ideas. At the risk of offending some of our over-enthusiastic friends, we will go further and insist that no profession is safe whose practices are based on anything other than the best product of trained minds schooled in the rigid methods of scientific research. That is not to say that only such persons can make valuable contributions to knowledge, but we do say that only when such ideas have been subjected to controlled research should a profession adopt them as a part of its routine. Optometry is being held up to the ridicule of the scientific world by the unsupported claims and unorthodox methods of some of its protagonists.

In the matter of contact lenses, we feel that undergraduate instruction should be limited to orientation instruction, and that contact lens fitting in the nature of things is definitely a specialty and not a field to be entered into by all optometrists. As a consequence of these ideas our present thought is that thorough instruction is graduate work.

We are of the opinion that all Optometry Schools should be University affiliated. Also that perhaps one of the most urgent needs of the profession is one or more Graduate Schools in which advanced studies may be pursued with ample space and liberal endowment so that the type of research we have spoken of may be carried on on a scale commensurate with the importance of the sense of sight.

Los Angeles, with its huge and varied resources in men and material, would be an ideal center for such an enterprise—and speaking personally, nothing would please me better than to see the institution to which I have contributed my best thought for a third of a century become the fuse for such an atomic development.

THE CANTONNET SYSTEM FROM THE VIEWPOINT OF GENERAL PSYCHOLOGY*

Eric Bateman†
Cornwall, England

A consideration of this subject is of vital importance to a correct appreciation of the "what and why" of orthoptic training. *What* are

---

*An abridgment of the material presented before the Middle East Optical Practitioners Group of the R.A.M.C., January 17, 1946. Submitted on August 9, 1946, for publication in the October 1946 issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY. From Volume 2, Transactions of the Middle East Optical Practitioners Group.

†Fellow, British Optical Association. (Hons).

you training? The mind of an individual. *What* are you doing? Breaking down a repression or "neurosis" of a localized type. The key to this statement may be found in Cantonnet's own remark that "an ocular repression of an image can be exactly likened to the repression in a more general way which occurs in the mind when faced with a situation which it finds intolerable." The mechanism is identical—the mind is constantly repressing intolerable situations, particularly at the deeper level of the emotions, and it is quite certain that an overlapping twin image of the outside world is intolerable: *ergo*, one eye deviates to throw an offending image off the most sensitive area of the receptor system and the mind at a higher level does the rest—it "represses" what may remain of the retinal stimulation and "represses" still more at the macula to avoid any temptation to swing back on the part of the turning eye.

It is considered essential therefore to consider the mechanism of repression in general terms and to precede this by a brief consideration of the pattern of a human mind (after Jung, in particular—Allers and Adler).

Anything outside the conscious mind can only be portrayed by analogy. In this sense let us refer to the diagram which conveniently portrays aspects of this matter, and let us start at the lowest level. This deepest level is at the level of the autonomous nervous system—and true reflexes common to the whole animal kingdom. Reactions to situations, e.g., hunger, heat, cold, fear, etc., are found at what we might call this universal level.

At the next stage up we find the essentially human reflexes, complexes and emotions, consisting, amongst other things, of racial images and instincts and race memories. It has been called the "half jungle of imagery and folk law." The sense of inadequacy — causing fear — is apparent here, hence the development (among others) of the religious instinct (not, of course, anything more than that at this level). Any "flaw" at this level causes or may cause a psychosis, i.e., a tension which is the result of the individual being completely unable to face "reality" with every aspect of his mind, hence a retirement to a world of phantasy. The world judges such a mind to be "insane." A psychosis can be caused, however, at the next stage up on our diagram. This is the section in which the characteristics of a person appears, and these are acquired from two sources of environment, (1) from the moment of quickening in the womb, the mind of an infant recapitulates the mental development of the race and is also under the control of its mother's emotions. Hence, if the mother has a deep conflict or fear, a rage or any

other strong emotion, the mind of the infant is undoubtedly "injected" at a very deep level. (2) After birth the child is conditioned by the external environment measured against its own innate requirements, i.e., protection and nurture. Any abnormal supply in either of these can sow the seed of a conflict or "repression," but generally, such comes later. For example, if a baby of 2-3 years is present at an emotional disagreement between the parents, innate loyalties are strained which the child dares not face because of its dependence on both parents, particularly the mother. Hence a first and early "repression" can occur which can build up a terrible tension through the years because the *cause* is unrecognised at the top level—the Ego—the conscious level.

The next level up brings us to a consideration of the subconscious, which we all recognise and use. Ordinary day-to-day events are pushed down here to allow us to tackle our work or the event of the moment. I have "forgotten" my mathematics, a play, a film, or what I had for dinner last Thursday week, but can "remember" them by withdrawing the appropriate memory-file from my subconscious. These are released sometimes with the assent of the Will and sometimes against the desires of the Will.

A repression may occur at the fairly superficial level of the subconscious, or, as has been mentioned, at the deeper level of the uncon-

Censor or Will here	EGO	level of intellectual development
	Subconscious level merging down to	
	The Unconscious of the Person	
	Human and Racial	
	At the deepest level characteristics in common with all living creatures (annual kingdom)	

scious mind, and *usually* since birth. This is described as a *neurosis*. Such a mind can face reality in all matters but that referring to the subject of his repression. Obviously, the farther back in Time the activating cause of such a repression occurred, the deeper it is situated in the "layers" of the mind and greater is the problem of the psychiatrist or the othoptist if the repression is an ocular one.

The Cantonnet technique of orthoptic training is really a specialised branch of applied psychology, re-educating from a low layer of the mind and causing the binocular visual function finally to be perfected, doing a job which Mother Nature herself would have done at an earlier age in the individual's life—if she could. In other words, a particular type of repression in a baby—horror of a two imaged world outside itself, is released and the binocular function may be developed. Or whilst the primitive "horror" may not be recognised, the function is still developed by the counterbalancing desire of the Ego, the "I." As is well known, the true reflex of convergence-divergence is made use of to do this.

"The active thought, the effort towards mental contemplation of a distant object placed above the horizon causes the eye to diverge: mental active vision of an object placed near and below the visual plane causes convergence."—(Cantonnet).

If the patient is aged, say, 16 years, strength is drawn from all "layers" of the mind (in our diagram) up to and including the ego development of that age. The primitive desire, from the point of arrested development is harnessed to now higher forces of function reinforced by the ego and the will itself (the intellectual desire to correct the defect and be as others are, etc.) and all aspects of the mind co-operate in forging ahead to develop the required function.

The order of treatment is probably known but is repeated here for the sake of completeness:

(1) Careful correction of the error of refraction.
(2) Correction of the amblyopia as much as possible.
(3) Exercises to overcome the repression (Neutralisation Cantonnet calls it).
(4) Development of simultaneous; and
(5) Stereoscopic vision.

It is hoped that this very brief paper on the subject may stimulate the interest of others, and in particular, lead to a consideration of the status of orthoptics and the qualifications of those who would practice it.

BRIDGE HOUSE, LOOE.

ANNOUNCEMENTS

1947 READING CLINIC INSTITUTES: THREE-YEAR PROGRAM

During 1947, the Reading Clinic staff, Department of Psychology, Temple University, will sponsor three institutes: two one-week institutes for professional workers and a one-day institute for parents. At the mid-winter institute (February 3 to 7), procedures and materials on Remedial and Corrective Reading will be discussed and demonstrated; at the summer institute, Developmental Reading. A special institute for parents will be held on Thursday, March 6.

Beginning with the 1947 Clinic institutes, a three-year *evaluation* program will be initiated. This will make it possible for Boards of Education and State Departments of Education to send delegates for the dual purpose of organizing new programs and of evaluating existing programs. For 1947, the emphasis will be placed on the *general language* approach to the reading problem; for 1948, the *content area* approach; for 1949, the *semantic*, or *meaning*, approach. The theme for each year has been established to guide the organization of the remedial, corrective, and the developmental institutes.

Seminars, demonstrations and evaluations will be made by well-known specialists in reading and related fields. By setting up a three-year program of emphases, it is possible to make better use of visiting specialists.

The activities of the one-week institutes are differentiated to meet the needs of clinical workers, vocational guidance directors, and teachers in elementary and secondary schools and colleges.

Enrollment is limited by advance registration. For a copy of the program and other information regarding these institutes, write to Dr. Emmett Albert Betts, Director of the Reading Clinic, Temple University, Philadelphia 22, Pennsylvania.

FEINBERG PAMPHLET AVAILABLE

Optometrists wishing copies of the original pamphlet, "The Nurse in an Industrial Vision Program" by Richard Feinberg, O.D., which appeared in the September 1946 issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY, may secure same by writing to the Liberty Mutual Insurance Company, 175 Berkeley Street, Boston, Massachusetts.